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01 AERONAUTICS (GENERAL)

N76-17021*+ National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A SPECIAL BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 64, DECEMBER 1975
Dec. 1975 89 p
(NASA-SP-7037(64)) Avail: NTIS HC $4.00 (special price) CSCL 01A

This bibliography lists 288 reports, articles, and other documents introduced into the NASA scientific and technical information system in November 1975. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N76-17022*# George Washington Univ., Washington, D.C.
AN INVESTIGATION OF AIRFLOW OVER THE AFT PORTIONS OF A VARIABLE SWEEP FIGHTER CONFIGURATION M.S. Thesis
Ernald B. Graves Dec. 1975 74 p refs
(NASA-CR-146361) Avail: NTIS HC $4.50 CSCL 01A

An investigation of air flow over the aft portions of a variable sweep fighter aircraft configuration was made. Tests conducted in the unitary plan wind tunnel at Mach number 2.16 included measurements of forces, moments, and local static pressures as well as visual recordings of the air flow. An aerodynamic analytical prediction method was evaluated when used in data comparison at angles of attack of 0, 5, and 15 degrees. The results indicate that in supersonic flow the typical outboard located twin vertical tail arrangement tends to provide a more positive increment in normal-force on the afterbody fuselage and the horizontal tail than a single center-mounted vertical tail of similar planform shape. In addition, the results indicate that a method for aerodynamic analysis of wing-body-tail configurations currently available can provide reasonable estimates of pressure coefficient distributions on configurations in regions of complex supersonic flow. At this time, however, the available analytical method cannot adequately replace experimental wind tunnel tests for determining the supersonic flow environment of a given configuration. Author

N76-17023*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF INLET STAGE OF TRANSONIC COMPRESSOR
Donald C. Urasek, Ronald J. Steinke, and George W. Lewis, Jr.
Washington Feb. 1976 72 p refs
(NASA-TM-X-3345; E-8056) Avail: NTIS HC $4.50 CSCL 01A

The overall and blade-element performances are presented over the stable flow operating range of the stage at the design tip speed of 426 m/sec. Stage peak efficiency of 0.83 was obtained at a weight flow of 28.8 kg/sec and a pressure ratio of 1.52. The stall margin for the stage was 8 percent based on weight flow and pressure ratio at peak efficiency and stall. The rotor appears to be stalling prematurely as evidenced by high rotor tip losses. Author

N76-17024*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A LOW-PRESSURE FAN STAGE WITH REVERSE FLOW
Royce D. Moore, George W. Lewis, Jr., and Edward R. Tysl
Washington Feb. 1976 63 p refs
(NASA-TM-X-3349; E-8482) Avail: NTIS HC $4.50 CSCL 01A

The reverse flow aerodynamic performance of a 51-centimeter-diameter fan stage is presented. The stage was tested with the variable pitch rotor blades set through feather at -75 deg, -80 deg, and -85 deg from design setting angle. Of the three tested the stage with the rotor blades set at -75 deg exhibited the highest pressure ratio and highest flow. For all three configurations, there was little or no flow in the inner third of the exit passage due to the rotor blade being almost perpendicular to the axial direction in the hub region. Author

N76-17025*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
FURTHER STUDIES OF STALL FLUTTER AND NONLINEAR DIVERGENCE OF TWO-DIMENSIONAL WINGS Final Report, Jun. 1974 - Aug. 1975
John Dugundji and Inderjit Chopra Aug. 1975 87 p refs
(Grant NsG-1051)
(NASA-CR-144924; ASRL-TR-180-1) Avail: NTIS HC $5.00 CSCL 01A

An experimental investigation is made of the purely torsional stall flutter of a two-dimensional wing pivoted about the midchord, and also of the bending-torsion stall flutter of a two-dimensional wing pivoted about the quarterchord. For the purely torsional flutter case, large amplitude limit cycles ranging from + or - 11 to + or - 160 degrees were observed. Nondimensional harmonic coefficients were extracted from the free transient vibration tests for amplitudes up to 80 degrees. Reasonable nondimensional correlation was obtained for several wing configurations. For the bending-torsion flutter case, large amplitude coupled limit cycles were observed with torsional amplitudes as large as + or - 40 degrees. The torsion amplitudes first increased, then decreased with increasing velocity. Additionally, a small amplitude, predominantly torsional flutter was observed when the static equilibrium angle was near the stall angle. Author

N76-17026*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AIRFOIL SECTION DRAG REDUCTION AT TRANSONIC SPEEDS BY NUMERICAL OPTIMIZATION
Raymond M. Hicks, Garret N. Vanderplaats, Earll M. Murman

(Flow Res., Inc., Kent, Wash.), and Rosa R. King (Computer Sci. Corp., Mountain View, Calif.) Feb. 1976 34 p refs
(NASA-TM-X-73097; A-6407) Avail: NTIS HC $4.00 CSCL 01A

A practical procedure for the design of low drag, transonic airfoils is demonstrated. The procedure uses an optimization program, based on a gradient algorithm coupled with an aerodynamic analysis program, that solves the full, non-linear potential equation for transonic flow. The procedure is useful for the design of retrofit modifications for drag reduction of existing aircraft as well as for the design of low drag profiles for new aircraft. Results are presented for the modification of four different airfoils to decrease the drag at a given transonic Mach number. Author

N76-17027*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
SOME PECULIARITIES OF THE FLOW AROUND SPHERICALLY BLUNTED CONES WITH LARGE SEMI-ANGLES AT HYPERSONIC SPEEDS
A. V. Krasilnikov, A. N. Nikulin, and A. S. Kholodov Washington NASA Jan. 1976 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), Mar.-Apr. 1975 p 179-181
(Contract NASw-2789)
(NASA-TT-F-16858) Avail: NTIS HC $3.50 CSCL 01A

The results are given of computer numerical calculations of the flow around spherically blunted cones with large semiangles at hypersonic speeds within the framework of a model of the completed gas with the attack angle alpha = 0. The peculiarities of the flow around such bodies with a changed semiangle and adiabatic value gamma are described. Author

N76-17028*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
FLOW AROUND BLUNTED CONES UPON ENTRY INTO AN ATMOSPHERE CONSISTING OF CARBON DIOXIDE AND NITROGEN
Yu. P. Golovachev and F. D. Popov Washington NASA Jan. 1976 8 p refs Transl. into ENGLISH from Mekh. Zhidk. Gaza (USSR), Mar. - Apr. 1975 p 175-178
(Contract NASw-2789)
(NASA-TT-F-16855) Avail: NTIS HC $3.50 CSCL 01A

The hypersonic flow around spherically blunted cones, consisting of carbon dioxide and nitrogen is studied. The problem is solved based on dynamic equations of viscous radiating gas without separation in the impact layer for areas of the nonviscous flow and the boundary layer. Calculations for the flow around blunted cones were also conducted for mixtures with different nitrogen content. Results of these calculations show that changes in the initial nitrogen content basically affect the radiation heating of the body surface. The convective heat flow, the friction coefficient, pressure distribution, and the shape of the impact wave have a very small relationship to the mixture content. Author

N76-17029*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
FLOW BEHAVIOR IN INLET GUIDE VANES OF RADIAL TURBINES
J. Sokhey, W. Tabakoff, and W. M. Hosny Oct. 1975 33 p refs
(Contract NAS2-7850)
(NASA-CR-137632) Avail: NTIS HC $4.00 CSCL 20D

Scroll flow is discussed. Streamline pattern and velocity distribution in the guide vanes are calculated. The blade surface temperature distribution is also determined. The effects of the blade shapes and the nozzle channel width on the velocity profiles at inlet to the guide vanes are investigated. Author

N76-17030# Advisory Group for Aerospace Research and Development, Paris (France).
FLOW SEPARATION
Nov. 1975 584 p refs In ENGLISH; partly in FRENCH Presented at the Fluid Dyn. Panel Symp., Goettingen, Germany, 27-30 May 1975 Original contains color illustrations
(AGARD-CP-168) Avail: NTIS HC $13.75

Two dimensional and three dimensional laminar and turbulent separation phenomena in subsonic, transonic, and supersonic flows are reported. For individual titles, see N76-17031 through N76-17070.

N76-17031 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
AN ACCOUNT OF THE SCIENTIFIC LIFE OF LUDWIG PRANDTL
H. Schlichting *In* AGARD Flow Separation Nov. 1975 32 p refs (For availability see N76-17030 08-02)

After an introduction on Prandtl's professional career the following are dealt with in Part I: Boundary layer theory, wing theory at subsonic and supersonic speeds, theory of stability of laminar flow. Furthermore, in this section the following problems are touched on briefly: Fully developed turbulent flow with application to boundary layers, pipe flow and meteorology. Prandtl's contributions to development of wind tunnel techniques are also mentioned. In Part II some remarks are made on the large number of doctoral theses which have been supervised by Prandtl. Author

N76-17032 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LAMINAR SEPARATION AT A TRAILING EDGE
Jean-Pierre Guiraud and Rene Schmitt *In* AGARD Flow Separation Nov. 1975 5 p refs (For availability see N76-17030 08-02)

A model of incipient separation is provided for the trailing edge of a thin wing in incompressible very high Reynolds number flow. The model of separated flow, with a (small) recirculation zone, of streamwise length, is consistent with a matched asymptotic expansion scheme of solution of the Navier-Stokes equations in the vicinity of the trailing edge. The structure of the flow involves a triple deck of Sytchev's type very close to separation, embedded in another triple deck, of Stewartsons' type, which is relevant to the overall separated flow. Ignoring angle of attack effects, the flow depends on two constants: the value of vorticity in the recirculation zone and the precise position of separation, which is known already as far as order of magnitude is concerned. Author

N76-17033 Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
LAMINAR SEPARATION: A LOCAL ASYMPTOTIC FLOW DESCRIPTION FOR CONSTANT PRESSURE DOWNSTREAM
A. F. Messiter *In* AGARD Flow Separation Nov. 1975 10 p refs (For availability see N76-17030 08-02)
(Contract DAHC04-68-C-0033)

A theoretical model is proposed for the description of two dimensional, steady, incompressible, laminar boundary layer flow near a separation point. It is assumed that the pressure just downstream of separation is approximately constant, and asymptotic solutions are then sought for large Reynolds number and small distance. The first two terms of the complex perturbation velocity in the external flow are shown to imply a pressure gradient upstream which is generally favorable, and adverse only for a short distance. This representation is no longer valid in a small neighborhood of the separation point where an interaction of the boundary layer with the external flow must be taken into account. Solutions are obtained for the boundary layer just upstream and, with an additional assumption, for the region of backflow just downstream of this region. A brief review and extension are also given for an asymptotic model of the complete wake behind a circular cylinder, with the assumption of nonzero drag at infinite Reynolds number. Author

N76-17034 Ruhr Univ., Bochum (West Germany).
DEPENDENCE OF LAMINAR SEPARATION ON HIGHER ORDER BOUNDARY LAYER EFFECTS DUE TO TRANSVERSE CURVATURE, DISPLACEMENT, VELOCITY SLIP AND TEMPERATURE JUMP
A. Wehrum *In* AGARD Flow Separation Nov. 1975 12 p refs (For availability see N76-17030 08-02)

The laminar compressible higher order boundary layer along a circular cylinder in an axial parallel supersonic flow is studied according to the method of matched asymptotic expansions. A weak constant mass flow is injected into the boundary layer through the surface of the cylinder. As a consequence of the

homogeneous mass injection the first order boundary layer solution already leads to separation of the boundary layer within a finite distance from the leading edge. In a second order theory the influence of higher order boundary layer effects, such as transverse curvature, displacement, velocity slip and temperature jump, on the wall shear stress and the location of the separation point is studied. As numerical results show, transverse curvature and low density effects due to velocity slip and temperature jump at the wall increase the wall shear stress and therefore lead to a downstream shifting of the separation point. Displacement effect increases the wall shear stress near the leading edge. Author

N76-17035 Cincinnati Univ., Ohio.
EVALUATION OF SEVERAL APPROXIMATE MODELS FOR LAMINAR INCOMPRESSIBLE SEPARATION BY COMPARISON WITH COMPLETE NAVIER-STOKES SOLUTIONS
K. N. Ghia, U. Ghia, and W. A. Tesch (GE, Co., Evendale, Ohio) *In* AGARD Flow Separation Nov. 1975 15 p refs (For availability see N76-17030 08-02)
(Grant NSF GK-35514)

Several approximate mathematical models have been analyzed for studying laminar separation for incompressible flow, for which the Navier-Stokes equations comprise an exact mathematical model. Two model flow configurations have been used. The first configuration considered consists of the flow in the boundary layer on a two dimensional semi-infinite slab with a vertical leading face and shoulders, with varying degree of bluntness, forming an external corner on the body. The second flow configuration represents a class of two dimensional bodies with an internal corner and a more pronounced separation region; this configuration is used for only one approximate model so far. Results obtained with the various approximate models are evaluated by comparison with the corresponding Navier-Stokes solutions. All the models considered lead to improved results as the Reynolds number is increased. Author

N76-17036 Queen Mary Coll., London (England).
NUMERICAL INVESTIGATION OF REGULAR LAMINAR BOUNDARY LAYER SEPARATION
H. P. Horton *In* AGARD Flow Separation Nov. 1975 12 p refs (For availability see N76-17030 08-02)

An accurate numerical procedure of the differential difference type for the solution of the incompressible laminar boundary layer equations is presented. The procedure is applicable to both direct problems, in which the pressure distribution is prescribed, and inverse problems of the type in which the wall shear is prescribed. Some examples computed by this procedure show that, by prescribing the wall shear to be regular in the vicinity of separation, the usual singularity at separation is avoided. Results are also presented in which downstream marching with prescribed wall shear has been continued to considerable distances beyond separation, including an example in which both regular separation and re-attachment occur. In other cases no solution to the inverse problem can be found beyond a short distance after separation, but by smoothly joining a prescribed pressure distribution to that calculated in the inverse problem upstream, it has been found possible to continue the computation as a direct problem. Questions of stability and uniqueness of the solutions are discussed. Author

N76-17037 Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
FINITE DIFFERENCE SOLUTIONS FOR SUPERSONIC SEPARATED FLOWS
M. J. Werle, A. Polak, V. N. Vatsa, and S. D. Bertke *In* AGARD Flow Separation Nov. 1975 12 p refs (For availability see N76-17030 08-02)
(Contracts F33615-73-C-4014; N00019-73-C-0223; N60921-74-C-0203)

Laminar and turbulent separation bubbles are addressed for a wide range of geometries using an implicit finite difference technique to solve the interacting boundary layer equations. Solutions are presented for laminar compression ramps at M = 4 and 6, wall temperature ranges of 0.2 to 1.0 and angles of sweep (yaw) relative to the mainstream of up to 60 deg. In addition, solutions for laminar flow over wavy walls with multiple separation bubbles are given here for M = 3. Application of the approach to turbulent separated flows ahead of a compression ramp at M = 3 is also considered. Author

N76-17038 Centre National de la Recherche Scientifique, Meudon (France). Lab. d'Aerothermique.
SEPARATION BUBBLE PRODUCED BY A SHALLOW DEPRESSION IN A WALL UNDER LAMINAR SUPERSONIC FLOW CONDITIONS [BULBE DE DECOLLEMENT PRODUIT PAR UNE FAIBLE DEPRESSION DE PAROI EN ECOULEMENT LAMINAIRE SUPERSONIQUE]
B. Prunet-Foch, F. Legay-Desesquelles, and G. B. Diep *In* AGARD Flow Separation Nov. 1975 9 p refs In FRENCH; ENGLISH summary (For availability see N76-17030 08-02)

In supersonic flow, a shallow deformation on a flat plate induces a small separated bubble in the boundary layer. In order to predict this laminar separation and reattachment process including heat transfer phenomena at the wall, a theoretical study was built up, using Dorodnitsyn integral's method as well as expressions suggested by Nielsen for the velocity and temperature profiles. Thereby the calculation can be carried out up to the reattachment point. Simultaneously experiments were made in a wind tunnel. Experimental and predicted results are in good agreement. Author

N76-17039 Ohio State Univ., Columbus. Dept. of Aeronautical Engineering.
ASYMPTOTIC THEORY OF SEPARATION AND REATTACHMENT OF A LAMINAR BOUNDARY LAYER ON A COMPRESSION RAMP
Odus R. Burggraf *In* AGARD Flow Separation Nov. 1975 9 p refs (For availability see N76-17030 08-02)
(Contract N00014-07-A-0232-0014)

Laminar boundary layer separation and reattachment is here considered for adiabatic flow over a compression ramp with supersonic mainstream. For large ramp angle, calculations based on the Stewartson-Williams triple deck theory show that the regions of separation and reattachment become distinct, with an intervening (plateau) region of nearly constant pressure. The mathematical description of each of these distinct regions is given, and simple formulas derived for a number of quantities of interest, including the plateau pressure, conditions at separation and reattachment, and the geometry of the separated region. Detailed comparisons of the theoretical results with available experimental data show favorable agreement. Author

N76-17040 Technische Hogeschool, Delft (Netherlands).
ON THE CALCULATION OF LAMINAR SEPARATION BUBBLES IN TWO-DIMENSIONAL INCOMPRESSIBLE FLOW
J. L. VanIngen *In* AGARD Flow Separation Nov. 1975 16 p refs (For availability see N76-17030 08-02)

A new laminar boundary layer calculation method is presented which combines the simplicity of Thwaites' method for the prediction of the momentum loss thickness with the accuracy of Stratford's two layer method for the prediction of the position of laminar separation. Calculated boundary layer characteristics for arbitrarily prescribed pressure distributions in general show a singular behavior at separation. It is shown that a real separating flow tends to adjust itself in such a way that the resulting pressure distribution prevents singular behavior of the boundary layer. An earlier method for the prediction of transition in attached boundary layers, based on linear stability theory, is extended to the case of separated flows. Two methods are discussed which might be used to predict whether reattachment of the turbulent shear layer will occur. Finally some results are discussed of wind tunnel experiments on the FX 66-S-196-V1 Wortmann airfoil, and on a circular cylinder with a tapered tail. Author

N76-17041 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
TURBULENT SEPARATION IN TWO-DIMENSIONAL FLOW [DECOLLEMENT TURBULENT EN ECOULEMENT BIDIMENSIONNEL]
Maurice Sirieix *In* AGARD Flow Separation Nov. 1975 27 p refs In FRENCH; ENGLISH summary (For availability see N76-17030 08-02)

The general features of separated turbulent flow regions are

defined and in particular a discussion is made on the physical reality of strictly two dimensional turbulent flows. The three fundamental problems which occur in the detailed experimental analysis of a separated zone, i.e.: separation, reattachment and coupling, are considered successively and the main factors of influence which rule these phenomena according to the subsonic-transonic-supersonic nature of the flow are presented. Lastly, a rapid review of the methods of prediction currently available is made. Author

N76-17042 Queen Mary Coll., London (England).
MEASUREMENTS IN SEPARATING TWO DIMENSIONAL TURBULENT BOUNDARY LAYERS
J. Chu and A. D. Young *In* AGARD Flow Separation Nov. 1975 12 p refs Sponsored by Min. of Defence (For availability see N76-17030 08-02)

Two different types of pressure distribution resulting in separation were induced in the flow over a flat plate zero incidence. Measurements were made of velocity distributions, skin friction, turbulence components and shear stress distributions at various stations both prior to and just after separation. The results have been compared with the predictions of various theories. Of these only those of Bradshaw and of Kuhn and Nielsen showed good agreement for integral quantities with the measurements right up to the separation point, the predictions of the remaining methods tended to depart radically from the measurements some little distance ahead of separation. Significant differences were found, however, between the measured shear stress distributions near separation and the predictions of Bradshaw's method, these differences indicate where improvements to the method may be made. With certain important provisos the methods of Stratford and Townsend for predicting the separation position are shown to be fairly reliable. Author

N76-17043 Southern Methodist Univ., Dallas, Tex. Dept. of Civil and Mechanical Engineering.
CHARACTERISTICS OF A SEPARATING INCOMPRESSIBLE TURBULENT BOUNDARY LAYER
Roger L. Simpson *In* AGARD Flow Separation Nov. 1975 14 p refs (For availability see N76-17030 08-02)
(Grants DA-ARO(D)-31-124-72-G31; DAHC04-74-G-0024; DAHC04-75-G-0051)

Laser and hot film anemometer measurements upstream and downstream of the separation zone are presented for a nominally two dimensional incompressible turbulent boundary layer for an airfoil type flow. The directionally sensitive laser anemometer measurements indicate that the location of intermittent separation as defined by Sandborn is the proper location of where the flow first deflects from the wall to relieve the imposed pressure gradient. Upstream of separation the correlations of Perry and Schofield for mean velocity profiles are supported within the uncertainty of the data. The separated flow field shows some profile similarity for all measured quantities. The normal stress terms in the momentum and turbulence energy equations are shown to be important near separation and cannot be neglected for the close prediction of the separation location. Author

N76-17044 McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
THE PREVENTION OF SEPARATION BY BLOWING IN TWO-DIMENSIONAL FLOW
B. G. Newman and H. P. A. H. Irwin (Natl. Res. Council of Can.) *In* AGARD Flow Separation Nov. 1975 13 p refs (For availability see N76-17030 08-02)

Two methods have been developed for calculating the jet momentum required to prevent the separation of the two dimensional incompressible turbulent boundary layer in adverse pressure gradients. The first was a strip integral method for plane walls the shear stress at each limit being based on measurements in self preserving wall jets. The second is an extension of differential methods which uses four model equations for the individual Reynolds stresses and one equation for the rate of turbulence dissipation. In general, the differential method is more accurate particularly when the outer wake is large. However, as used, this method required more input data and was about three times more expensive to run. The integral method is therefore still useful and is not limited to low curvature. Author

N76-17045 Boeing Commercial Airplane Co., Seattle, Wash. Aerodynamics Research Unit.
THE ANALYSIS OF FLOW FIELDS WITH SEPARATION BY NUMERICAL MATCHING
G. W. Brune, P. E. Rubbert, and C. K. Forester *In* AGARD Flow Separation Nov. 1975 8 P refs (For availability see N76-17030 08-02)
(Contract F33615-73-C-3037)

A computing method is reported for flow fields characterized by the presence of viscous, separated regions interacting strongly with a surrounding inviscid flow. The procedure is to divide the flow field into several regions, each dominated by a particular type of fluid physics, and to analyze each region by using the numerical solution technique that is computationally optimum for the dominant type of flow. The paper specifically addresses the problem of matching a numerical solution of the Navier-Stokes equations for a region containing separated flow with another numerical solution appropriate for an adjacent region of inviscid flow. A key feature of the method presented is the placement of the matching boundary in space occupied by purely inviscid flow and remote from local areas of strong viscous/inviscid interactions. A detailed study and numerical substantiation of the method are presented for axisymmetric flow over an ellipsoid of revolution with laminar separation. Author

N76-17046 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
EXPERIMENTAL AND THEORETICAL INVESTIGATIONS OF TWO-DIMENSIONAL REATTACHMENT IN TURBULENT INCOMPRESSIBLE FLOW [ETUDE EXPERIMENTALE ET THEORIQUE DU RECOLLEMENT BIDIMENSIONNEL TURBULENT INCOMPRESSIBLE]
Jean-Claude LeBalleur and Jean Mirande *In* AGARD Flow Separation Nov. 1975 13 p refs In FRENCH; ENGLISH summary (For availability see N76-17030 08-02)

Turbulent reattaching flow downstream of a backward facing step has been experimented using a two dimensional plane incompressible configuration, with possibility to induce favorable or adverse pressure gradients in the potential flow near reattachment. A whole calculation has been performed by obtaining self induced interaction in matching a wall dissipative layer with an inviscid and irrotational external flow. Except for weak viscous interaction regions, an inverse calculation process is used to avoid singularities following the Klinerberg's method for transonic aerofoils. Wall pressure distribution then results of an integral boundary layer calculation, whose failure for strongly separated regions is easily overcome by substitution of an empirical pressure law. Author

N76-17047 Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
THREE DIMENSIONAL DISTURBANCES IN REATTACHING SEPARATED FLOWS
G. R. Inger *In* AGARD Flow Separation Nov. 1975 12 p refs (For availability see N76-17030 08-02)

Two possible causes of the pronounced periodic spanwise disturbances that have been observed in nominally two dimensional or axi-symmetric reattaching laminar and turbulent separated flows are studied theoretically. Approximate analytical compressible small disturbance flow models for both a local vortex instability mechanism and the effect of a row of incoming streamwise vortices are set up, solved and compared with available experimental data on surface disturbance pattern, pressure and heat transfer. The results on all counts confirm the predictions of the vortex instability model. It is also shown that Reynolds analogy does not apply to the disturbance skin friction and heat transfer. Author

N76-17048 Naval Surface Weapons Center, White Oak, Md.
AN EXPERIMENTAL INVESTIGATION OF THE COMPRESSIBLE TURBULENT BOUNDARY LAYER SEPARATION INDUCED BY A CONTINUOUS FLOW COMPRESSION
Robert L. P. Voisinet *In* AGARD Flow Separation Nov. 1975 11 p refs (For availability see N76-17030 08-02)

Flow field measurements of a compressible turbulent boundary layer on nozzle wall separation are presented. A continuous compression of the nozzle flow was imposed on the thick nozzle wall boundary layer to produce a streamwise pressure rise of

sufficient strength to cause separation. The effects of Reynolds number on the separation phenomena are presented. For Reynolds numbers below 8. x 100,000 the separation length was found to increase with increasing Reynolds number, whereas for Reynolds numbers above 8. X 100,000 the reverse trend was observed. This reversal in the separation length versus Reynolds number trend was consistent with the reversal observed for incipient separation versus Reynolds number correlations. Author

N76-17049 Cranfield Inst. of Technology (England). Aerodynamics Div.

LAMINAR AND TURBULENT BOUNDARY LAYER SEPARATION AT SUPERSONIC AND HYPERSONIC SPEEDS

John L. Stollery *In* AGARD Flow Separation Nov. 1975 11 p refs (For availability see N76-17030 08-02)

A number of theoretical and experimental investigations of shock boundary layer interaction are discussed. Both laminar and turbulent layers are considered, growing over two dimensional and axisymmetric bodies. For laminar flow a simplified version of the momentum integral method has been developed and used to predict incipient separation. A number of comparisons between experiment and theory for attached, incipient and well separated flows are included. For turbulent flow the three layer model proposed by Elfstrom is shown to give good quantitative estimates of incipient separation and to explain the Reynolds number trend found experimentally. Since the turbulent boundary layer is more resistant to shock interference a very simple attached flow theory is derived, which gives good predictions of both pressure and heat transfer at hypersonic speeds. Author

N76-17050 Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

INCIPIENT SEPARATION OF A COMPRESSIBLE TURBULENT BOUNDARY LAYER

C. Appels and B. E. Richards *In* AGARD Flow Separation Nov. 1975 12 p refs (For availability see N76-17030 08-02)

The separation of a turbulent boundary layer is studied that developed on nozzle walls induced by a compression corner at Mach numbers of 3.5 and 5.4 over a range of Reynolds numbers based on boundary layer thickness of 100,000 to 1 million. Careful application of liquid line and schlieren flow visualization techniques were used to detect separated length down to one tenth of boundary layer thickness. In this way separation was detected at lower flap angles than has been previously found at these conditions. The related finding of low incipient separation angle implies that flow reversal may occur initially only in the laminar sublayer, and this is confirmed by applying simple laminar correlations to this layer. This measured value of alpha sub i is found to be little dependent on Mach number and it is concluded that the large dependence of alpha sub i on this parameter found earlier is explained by each experiment detecting a different degree of onset of separation. The measured variation of alpha sub i with Reynolds number appears to follow the trend of development of the wake component in the undisturbed boundary layer. Author

N76-17051* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE CALCULATION OF SUPERSONIC SEPARATING AND REATTACHING FLOWS

John D. Murphy, Leroy L. Presley, and William C. Rose *In* AGARD Flow Separation Nov. 1975 12 p refs (For availability see N76-17030 08-02)

CSCL 01A

A method is developed for solving the laminar and turbulent compressible boundary layer equations for separating and reattaching flows. Results of this method are compared with experimental data for two laminar and three turbulent layer, shock wave interactions. Several Navier-Stokes solutions are obtained for each of the laminar boundary layer, shock wave interactions considered. Comparison of these solutions indicates a first order sensitivity in C sub f to the computational mesh selected in both the viscous and inviscid portions of the flow. Comparison of the present boundary layer solutions with the Navier-Stokes solutions and with data for a given Mach number indicates that as long as the separation bubble is small, the boundary layer approximation yields solutions whose accuracy is comparable to the Navier-Stokes solutions. Author

N76-17052 Aerospace Research Labs., Wright-Patterson AFB, Ohio.

SUPERSONIC TURBULENT SEPARATED FLOWS UTILIZING THE NAVIER-STOKES EQUATION

J. S. Shang and W. L. Hankey, Jr. *In* AGARD Flow Separation Nov. 1975 13 p refs (For availability see N76-17030 08-02)

A modified eddy viscosity model is incorporated into the compressible Navier-Stokes equations and numerical solutions obtained for separated flows. The modification attempts to reproduce the response of a turbulent boundary layer to a severe pressure gradient by introducing a simple rate equation to account for the relaxation phenomenon. The system of equations is solved by MacCormack's time splitting explicit numerical scheme for a series of compression corner configurations. Computations are performed for ramp angle varying from 15 to 25 degrees at a Mach number of 2.96 and Reynolds number of 10 to the 7th power. An incident oblique shock impingement case is also computed at these same conditions and included for comparison with a ramp induced separation case. Calculations utilizing the modified eddy viscosity for the interacting turbulent flow compare very well with experimental measurements for the compression ramps, particularly, in the prediction of the upstream pressure propagation and location of the separation and reattachment points. Good agreement is also attained between the measured and the calculated density profiles in the viscous inviscid interaction region. Author

N76-17053* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AN EXPERIMENTAL AND NUMERICAL INVESTIGATION OF SHOCK WAVE INDUCED TURBULENT BOUNDARY LAYER SEPARATION AT HYPERSONIC SPEEDS

J. G. Marvin, C. C. Horstman, M. W. Rubesin, T. J. Coakley, and M. I. Kussoy *In* AGARD Flow Separation Nov. 1975 13 p refs (For availability see N76-17030 08-02)

CSCL 01A

A thoroughly documented experiment is reported that was specifically designed to test and guide computations of the interaction of an impinging shock wave with a turbulent boundary layer. Detailed mean flow field and surface data are presented for two shock strengths which resulted in attached and separated flows, respectively. Numerical computations are used to illustrate the dependence of the computations on the particulars of the turbulence models. Models appropriate for zero pressure gradient flows predicted the overall features of the flow fields, but were deficient in predicting many of the details of the interaction regions. Improvements to the turbulence model parameters were sought through a combination of detailed data analysis and computer simulations which tested the sensitivity of the solutions to model parameter changes. Computer simulations using these improvements are presented and discussed. Author

N76-17054 Nielsen Engineering and Research, Inc., Mountain View, Calif.

PREDICTION OF TURBULENT SEPARATED FLOW AT SUBSONIC AND TRANSONIC SPEEDS INCLUDING UNSTEADY EFFECTS

Gary D. Kuhn and Jack N. Nielsen *In* AGARD Flow Separation Nov. 1975 16 p refs (For availability see N76-17030 08-02)

An integral boundary layer method is extended to calculation of separated turbulent boundary layers in steady flow and to unsteady turbulent boundary layers. Separated boundary layers are calculated by treating the pressure as a dependent variable and prescribing the wall shear variation. The boundary layer method and a suitable potential flow method are used in an iterative procedure to produce a method for predicting the characteristics of separated flows. Good comparisons are shown between the theory and data for a separated turbulent boundary layer on the wall of a transonic wind tunnel. Analytical solutions developed from a small perturbation analysis indicate the method is valid for unsteady flow over a certain range of frequencies. Good comparisons were obtained between the linearized theory and results produced by a finite difference solution of the complete nonlinear unsteady boundary-layer equations. Examination of the nature of the integral equations in the vicinity of a point of zero wall shear stress indicates that the shear stress gradient decreases approaching the point of zero shear. Author

N76-17055 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
VISCOUS INTERACTIONS WITH SEPARATION UNDER TRANSONIC FLOW CONDITIONS [INTERACTION VISQUEUSE AVEC DECOLLEMENT EN ECOULEMENT TRANSSONIQUE]
J. Delery, J. J. Chattot, and J. C. LeBalleur *In* AGARD Flow Separation Nov. 1975 13 p refs In FRENCH; ENGLISH summary (For availability see N76-17030 08-02)

Strong viscous interactions which are present in transonic flows past airfoils give rise to an important thickening of the boundary layer with the frequent formation of a separated region. Under such conditions, the calculation of the flow must call upon rapid interaction theories whose application for the case of a turbulent boundary layer is examinated in conjunction with experimental analysis. A detailed analysis of the flow field has been made by using interferometry and a method of calculation similar to Klineberg's approach. The principle of this theory is to divide the flow into two domains: a weak interaction region where the pressure gradient is moderate, and a rapid interaction region if separation is likely to occur. Author

N76-17056 Technische Hochschule, Aachen (West Germany).
UNSTEADY SHOCK WAVE-BOUNDARY LAYER INTERACTION ON PROFILES IN TRANSONIC FLOW
Klaus Finke *In* AGARD Flow Separation Nov. 1975 11 p refs (For availability see N76-17030 08-02)

Many unsteady flows are characterized by the interaction of shock waves with separated boundary layers. In particular shock oscillations occur on thick airfoils at high angles of attack and transonic free stream Mach numbers. Measurements were carried out in an intermittent indraft tunnel to study shock oscillations on various two dimensional wings. Alternating separation and attachment at the leading edge is the observed severest type of the unsteady flow conditions. For this case multispark interferograms show periodical oscillations of the circulation of the wing, accompanied by the same oscillation of the circulation in the opposite sense in the wake. Large periodical disturbances exist throughout the entire flow field with defined phase shifts. The primary source of the observed instability is the shock induced separation of the boundary layer on the profile. Author

N76-17057 Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
SHOCK INDUCED FLOW OSCILLATIONS
G. E. A. Meier *In* AGARD Flow Separation Nov. 1975 9 p refs (For availability see N76-17030 08-02)

The physical system consisting of a shock wave and the downstream separated flow causes oscillatory instabilities in three cases described here: transonic flow in a curved channel; flow over a symmetric profile at angle of attack; and flow in a Laval nozzle. The shock boundary layer interaction creates or displaces a separation bubble, thereby changing the flow field downstream of the shock root. This process usually strengthens the shock wave by increasing the back pressure. The shock wave then becomes unsteady, moving the separation point with it in an upstream direction, so that a self preserving instability occurs, thus reducing the flow velocity in the whole transonic field. By means of the later reattachment of the boundary layer, the entire flow is accelerated and tends to return to the initial condition, i.e., the process is cyclic. The length of the oscillation periods can be estimated. Author

N76-17058 National Aerospace Lab., Amsterdam (Netherlands).
EXPERIMENT ON TRANSONIC SHOCK WAVE BOUNDARY LAYER INTERACTION
J. W. Kooi *In* AGARD Flow Separation Nov. 1975 10 p refs (For availability see N76-17030 08-02)

An experiment is described in which a normal shock interacts with a two dimensional turbulent boundary layer in an uniform flow with a Mach number of 1.4. The wall pressure distribution in the interaction region was measured and detailed pitot and static pressure surveys were made. The flow field was analyzed and no supersonic tongue was found downstream of the shock. The velocity profiles were integrated to obtain the integral properties whereas the skin friction was derived from Clauser plots. From the distribution of skin friction and the behavior of the integral properties it has been concluded that the boundary layer separated at the foot of the shock and reattached 4.5 undisturbed boundary layer thickness downstream of the separation point. The velocity profiles at the start of the interaction and downstream of the reattachment point correlate well with the logarithmic velocity distribution in the wall region. Author

N76-17059 Royal Aircraft Establishment, Farnborough (England).
A REVIEW OF SEPARATION IN STEADY, THREE-DIMENSIONAL FLOW
J. H. B. Smith *In* AGARD Flow Separation Nov. 1975 17 p refs (For availability see N76-17030 08-02)

An attempt is made to present a unified view which leads from a consideration of the structure of the problem and the role of modelling, through the partial solutions which have been found, to some illustrations of the application of three dimensional flow separation in aircraft design. Much of the work reported is only partially three dimensional, in the sense that boundary layers are calculated for flows over cones or infinite sheared wings and that slender body theory is used to calculate the separated flow. These treatments reveal the limitations of some two dimensional concepts like reattachment and present an exciting range of problems and possibilities. Author

N76-17060* R and D Associates, Santa Monica, Calif.
LAMINAR SEPARATION ON A BLUNTED CONE AT HIGH ANGLES OF ATTACK
Stephen C. Lubard *In* AGARD Flow Separation Nov. 1975 11 p refs (For availability see N76-17030 08-02)
(Contract NAS2-8113)

A new technique is reported for calculating the entire flow field on spherically blunted cones at high angles of attack and high laminar Reynolds numbers. An approximate system of parabolic equations obtained from the steady Navier-Stokes equations by assuming the viscous, streamwise derivative terms are small compared to the viscous normal and circumferential derivatives is the basis of the calculations. These equations are valid for both the inviscid and viscous regions, including the circumferential separation zone that develops on the leeward side at high angles of attack. Two different methods are used to obtain the initial conditions for these equations at the sphere cone tangency plane. For small nose Reynolds numbers, an axisymmetric merged layer solution around a sphere is rotated to provide a three-dimensional initial plane of data. For large nose Reynolds numbers, the nose region is solved using an inviscid, three dimensional time dependent solution combined with a boundary layer solution for the viscous flow. The computed flowfield including the leeward separation region is described and compared with data for a 7 deg half angle cone at 10 deg angle of attack, and a blunt 15 deg half angle cone at 15 deg angle of attack. Author

N76-17061 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
CALCULATION OF THE THREE DIMENSIONAL LAMINAR BOUNDARY LAYER AROUND BODIES OF REVOLUTION AT INCIDENCE AND WITH SEPARATION
Wolfgang Geibler *In* AGARD Flow Separation Nov. 1975 11 p refs (For availability see N76-17030 08-02)

A numerical method is presented to calculate the three dimensional laminar incompressible boundary layer over bodies of revolution at incidence. The inviscid flow velocities used for the boundary condition at the outer edge of the boundary layer are determined numerically by a singularity method. The boundary layer calculation is carried out in a streamline coordinate system. The coordinates are fixed to the streamlines and equipotential lines of the inviscid flow. The boundary layer equations are integrated by an implicit finite difference method. As a result of the numerical calculation process the velocity profiles in directions of streamlines and equipotential lines are known for each mesh point of the coordinate system. It is shown that this method can be used to determine the separation lines on the body surface. Author

N76-17062 National Aerospace Lab., Amsterdam (Netherlands).
THREE DIMENSIONAL SEPARATION OF AN INCOMPRESSIBLE TURBULENT BOUNDARY LAYER ON AN INFINITE SWEPT WING
A. Elsenaar, B. VandenBerg, and J. P. F. Lindhout *In* AGARD

Flow Separation Nov. 1975 15 p refs (For availability see N76-17030 08-02)

A three dimensional boundary layer flow under infinite swept wing conditions is simulated. A description is given of the development of the boundary layer in a region of an adverse pressure gradient leading to increased cross flows and finally terminating in a three dimensional separation. Measurements are reported of the mean velocity profiles, the wall shear stress and the components of the Reynolds stress tensor. These measurements reveal a decreasing mixing length with increased cross flow and a substantial difference between the direction of the shear stress and the velocity gradient. After the separation line a region with an almost spanwise flow is observed. Calculations are presented of the boundary layer development with a finite difference method using semi-empirical shear stress relations based on the turbulent energy equation. This method fails to predict separation. When empirical modifications, based on the experimental results are introduced, the agreement improves. Close to separation, however, the calculations are very sensitive to the pressure distribution and this might be related to a Goldstein-type singularity at separation. Author

N76-17063* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THREE DIMENSIONAL BOUNDARY LAYER SEPARATION IN SUPERSONIC FLOW

William D. Bachalo and Maurice Holt *In* AGARD Flow Separation Nov. 1976 13 p refs Prepared in cooperation with Calif. Univ., Berkeley (For availability see N76-17030 08-02)
CSCL 01A

An account is given of a detailed experimental investigation of three dimensional boundary layer separation in supersonic flow. In investigating three dimensional effects on supersonic separation, models were chosen which exhibited departures from two dimensional flow in the simplest way. The plane compression corner was replaced by a plate attached to a swept back wedge formed by two obliquely intersecting planes. Maintaining a constant tunnel Mach number of 2.5, surface pressure measurements were made on these models at static orifices spaced along the centerline and along three parallel lines. The flow parameters in the boundary layer and separated regions adjacent to the model surface were measured by traversing hot wire and pitot probes. The traverses were taken across the boundary layer and reversed flow regions in a direction normal to the body surface; they were made in several vertical planes, including the plane of symmetry. Author

N76-17064 Salford Univ. (England). Dept. of Mechanical Engineering.

PRESSURE RISE TO SEPARATION IN CYLINDRICALLY SYMMETRIC SHOCK WAVE, TURBULENT BOUNDARY LAYER INTERACTION

D. F. Myring *In* AGARD Flow Separation Nov. 1975 14 p refs (For availability see N76-17030 08-02)

Integral equations governing the three dimensional flow in a cylindrically symmetric shock wave - turbulent boundary layer interaction are written in the form of momentum equations for directions normal to and aligned with the line of the shock, plus an entrainment equation. By neglecting the contributions of surface friction and mass entrainment, direct dependence on spatial derivatives is removed and solutions are obtained using the Mager cross flow profiles and power law profiles for the streamwise flow. Results are produced for angles of sweep greater than 45 deg which show good agreement with experimental measurements of pressure rise to separation. For smaller angles of sweep the theory suggests that the skin friction becomes vanishingly small at separation, which in turn suggests the need for a modified separation criterion. Author

N76-17065 Ballistic Research Labs., Aberdeen Proving Ground, Md.

THE STRUCTURE OF THREE DIMENSIONAL SEPARATED FLOWS IN OBSTACLE, BOUNDARY LAYER INTERACTIONS

Raymond Sedney and Clarence W. Kitchens, Jr. *In* AGARD Flow Separation Nov. 1975 15 p refs (For availability see N76-17030 08-02)

The turbulent boundary layer on the wall of a continuous supersonic wind tunnel is studied. Sizeable separated flow regions can be studied since the wall width is 38 cm and the boundary layer is typically 2.5 cm thick. The large scale of the experiment is required to resolve the fine details of the flow structure. The flow visualization techniques are discussed. The variation of primary separation distance is presented as a function of M, R, and obstacle dimensions. Some scaling laws that have been proposed are not supported by our results. The structure of the separated flow upstream of the obstacle changes with relatively small changes in R; the number of vortices varies from 6 to 4 to 2 as R changes. Data are presented for large and small protuberances, but the latter are emphasized. Author

N76-17066 Rutgers Univ., New Brunswick, N.J. Dept. of Mechanical, Industrial, and Aerospace Engineering.

CINEMATOGRAPHIC STUDY OF SEPARATED FLOW REGIONS

R. H. Page and C. E. G. Przirembel *In* AGARD Flow Separation Nov. 1975 7 p refs (For availability see N76-17030 08-02)

A cinematographic study utilizing high speed motion picture photography was carried out for a series of supersonic separated flow configurations. A two dimensional variable Mach number wind tunnel was used to produce flow fields about several sting supported models, including a sphere, a blunt body with a leading spike and a missile. Color Schlieren and shadowgraph techniques were the primary diagnostic tools used in these studies. For some film sequences, these flow visualization techniques were enhanced by the addition of small particles. The chief results of these studies are presented in a 16mm color motion picture film. Excellent qualitative descriptions of various supersonic, separated flow fields have been obtained by viewing these high speed motion pictures on a reduced time scale or on a frame-by-frame basis. Author

N76-17067 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

PHENOMENOLOGICAL INVESTIGATIONS OF SEPARATED FLOW USING HYDRODYNAMIC VISUALIZATIONS [ETUDE PHENOMENOLOGIQUE A PARTIR DE VISUALISATIONS HYDRODYNAMIQUES]

Henri Werle *In* AGARD Flow Separation Nov. 1975 14 p refs In FRENCH; ENGLISH summary (For availability see N76-17030 08-02)

Thanks to flow visualizations obtained at a water tunnel since many years, it has been possible to undertake the physical study of separations around a broad variety of obstacles. From these results, obtained at low speed, emerge a number of fundamental schemes which correspond to the main types of separations observed in two- or three-dimensional flow; their detailed analysis emphasizes their singularities as well as their transitional, vortex like and unsteady aspects. A synthesis is proposed aiming at the characterization of three dimensional separations as compared to those occurring in plane or axisymmetrical flow. Author

N76-17068 National Aeronautical Establishment, Ottawa (Ontario).

THE THREE DIMENSIONAL SEPARATION OF A TURBULENT BOUNDARY LAYER BY A SKEWED SHOCK WAVE AND ITS CONTROL BY THE USE OF TANGENTIAL AIR INJECTION

David J. Peake and William J. Rainbird (Carleton Univ.) *In* AGARD Flow Separation Nov. 1975 34 p refs (For availability see N76-17030 08-02)

The three dimensional interaction of a skewed shock wave with a turbulent boundary layer, that is generated by a variable angle wedge standing normal to a flat test wall, has been systematically investigated at nominal mainstream Mach numbers of 2 and 4, up to and beyond shock strengths sufficient to cause incipient three dimensional separation. In the Mach number 2 flowfield, with wedge deflection angles of 8 and 11.5 deg, blowing air at Mach 3 was introduced upstream of the interaction and tangential to the wall. The objective was to control and remove the three dimensional separation. The jet excess momentum for this control situation was slightly more than the momentum deficit of the undisturbed boundary layer. In addition to the control of the magnitude of the blowing momentum, the direction of the wall jet could also be changed by rotating the

line of the jet efflux. The optimum direction of blowing was found to be along a line somewhere between the deflected surface of the wedge and the line of the oblique shock wave. Author

N76-17069 Princeton Univ., N.J.
AN EXPLORATORY OF A THREE DIMENSIONAL SHOCK WAVE BOUNDARY LAYER INTERACTION AT MACH 3
B. Oskam, I. E. Vas, and S. M. Bogdonoff *In* AGARD Flow Separation Nov. 1975 14 p refs (For availability see N76-17030 08-02)

An exploratory experimental investigation has been carried out on the three dimensional flow fields caused by the interaction of oblique shock waves and a planar turbulent boundary layer. The study was performed at a free stream Mach number of 2.95, a Reynolds number per inch of 1.6 x 106 and near adiabatic wall conditions. The interaction was studied on two experimental configurations having different initial boundary layer thicknesses. Both surface measurements as well as complete flow field surveys were performed. The main contributions of the present investigation are two experimentally derived flow field models for shock generator angles of 4 deg and 10 deg. Based upon both static pressure and surface flow patterns, as well as heat transfer data, the interaction region can be characterized as quasi-two-dimensional along the shock direction in the region studied. A critical examination of the occurance of ordinary flow separation and its character was carried out. It was concluded that McCabe's criterion is not a sufficient condition to determine the onset of flow separation. Author

N76-17070 General Dynamics/Convair, San Diego, Calif.
THE MANY FACETS OF 3D TRANSONIC SHOCK INDUCED SEPARATION
H. Yoshihara and D. Zonars (AF Flight Dynamics Lab.) *In* AGARD Flow Separation Nov. 1975 8 p refs (For availability see N76-17030 08-02)

Pressure distributions obtained in wind tunnel tests on several wing fuselage configurations at high subsonic Mach numbers are used to illustrate several shock induced separation scenarios that are essentially 3D in nature. Pearcey's Type B interactions, distinguished by prior history effects, appear in several different forms. The described results in general are characteristic primarily of aft-cambered airfoils. Author

N76-17071*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLUCTUATING PRESSURES IN FLOW FIELDS OF JETS
James C. Schroeder and John Kenneth Haviland (Virginia Univ.) Feb. 1976 21 p refs
(NASA-TM-X-71979) Avail: NTIS HC $3.50 CSCL 01A

The powered lift configurations under present development for STOL aircraft are the externally blown flap (EBF), involving direct jet impingement on the aircraft flaps, and the upper surface blown (USB), where the jet flow is attached on the upper surface of the wing and directed downwards. Towards the goal of developing scaling laws to predict unsteady loads imposed on the structural components of these STOL aircraft from small model tests, the near field fluctuating pressure behavior for the simplified cases of a round free cold jet and the same jet impinging on a flat plate was investigated. Examples are given of coherences, phase lags (giving convection velocities), and overall fluctuating pressure levels measured. The fluctuating pressure levels measured on the flat plate are compared to surface fluctuating pressure levels measured on full-scale powered-lift configuration models. Author

N76-17072*# Boeing Commercial Airplane Co., Seattle, Wash.
COMPUTATION OF THE TRANSONIC PERTURBATION FLOW FIELDS AROUND TWO- AND THREE-DIMENSIONAL OSCILLATING WINGS Final Report
Warren H. Weatherill, F. Edward Ehlers, and James D. Sebastian Washington NASA Dec. 1975 155 p refs
(Contract NAS1-13002)
(NASA-CR-2599; D6-42536) Avail: NTIS HC $6.75 CSCL 01A

Analytical and empirical studies of a finite difference method for the solution of the transonic flow about an harmonically oscillating wing are presented along with a discussion of the development of a pilot program for three-dimensional flow. In addition, some two- and three-dimensional examples are presented. Author

N76-17073*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF LOW-PRESSURE-RATIO LOW-TIP-SPEED FAN STAGE WITH BLADE TIP SOLIDITY OF 0.65
George Kovich and Ronald J. Steinke Washington Feb. 1976 97 p refs
(NASA-TM-X-3341; E-7604) Avail: NTIS HC $5.00 CSCL 01A

The overall and blade-element performance of a low pressure ratio, low tip speed fan stage is presented over the stable operating range at rotative speeds from 90 to 120 percent of design speed. Stage peak efficiency of 0.927 was obtained at a weight flow of 32.4 kg/sec (190.31 kg/sec/sq m of annulus area) and a pressure ratio of 1.134. The stall margin at design speed and peak efficiency was 15.3 percent. Author

N76-17074*# Washington Univ., Seattle.
A NON-GAUSSIAN MODEL OF CONTINUOUS ATMOSPHERIC TURBULENCE FOR USE IN AIRCRAFT DESIGN
Paul M. Reeves, Robert G. Joppa, and Victor M. Ganzer Jan. 1976 254 p refs
(Grant NGR-48-002-085)
(NASA-CR-2639) Avail: NTIS HC $9.00 CSCL 01A

A non-Gaussian model of atmospheric turbulence is presented and analyzed. The model is restricted to the regions of the atmosphere where the turbulence is steady or continuous, and the assumptions of homogeneity and stationarity are justified. Also spatial distribution of turbulence is neglected, so the model consists of three independent, stationary stochastic processes which represent the vertical, lateral, and longitudinal gust components. The non-Gaussian and Gaussian models are compared with experimental data, and it is shown that the Gaussian model underestimates the number of high velocity gusts which occur in the atmosphere, while the non-Gaussian model can be adjusted to match the observed high velocity gusts more satisfactorily. Application of the proposed model to aircraft response is investigated, with particular attention to the response power spectral density, the probability distribution, and the level crossing frequency. A numerical example is presented which illustrates the application of the non-Gaussian model to the study of an aircraft autopilot system. Listings and sample results of a number of computer programs used in working with the model are included. Author

N76-17075*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PRESSURE DISTRIBUTIONS FOR A RECTANGULAR SUPERSONIC INLET AT SUBSONIC SPEEDS
Dennis E. Fuller Washington Feb. 1976 478 p refs
(NASA-TM-X-3305; L-10424) Avail: NTIS HC $12.50 CSCL 01A

Pressure distribution data are provided for a supersonic rectangular inlet at subsonic speeds. Variations in cowl and ramp geometry as well as sideplate sweep were investigated. Tests were made in the Langley 16-foot transonic tunnel and the Langley high speed 7- by 10-foot tunnel for Mach numbers of 0.6, 0.7, and 0.8. Angles of attack investigated were 0 deg, 4 deg, and 8 deg for a range of mass flow ratios. Author

N76-17076# Naval Surface Weapons Center, White Oak, Md.
AN INVESTIGATION OF THE DAMPING IN PITCH CHARACTERISTICS OF A TEN DEGREE CONE
A. M. Morrison, J. E. Holmes, and W. R. Lawrence Jun. 1975 87 p refs
(AD-A015336; NSWC/WOL/TR-75-84) Avail: NTIS CSCL 16/2

A series of one-degree-of-freedom dynamic wind tunnel measurements were made for a standard Supersonic Tunnel Association ten degree cone with varying bluntnesses of .25, .1, .0167, and .07. Variations of the stability coefficients with angle-of-attack, bluntness, Reynolds number, and Mach number are obtained including Mach 18 data points for which no previous data existed. An explanation of reported difference between measured dynamic stability as obtained from ballistic range and wind tunnel techniques is offered. The equations of motion,

data reduction techniques and experimental methods are also developed. GRA

N76-17077# West Virginia Univ., Morgantown. Dept. of Aerospace Engineering.
HELICOPTER LIFTING SURFACE THEORY WITH FORCE FREE WAKES, PART 2
Hsi F. Chou and Jerome B. Fanucci Feb. 1975 91 p refs (Contract N00014-73-A-0417-0004; NR Proj. 215-232) (AD-A015192; TR-44) Avail: NTIS CSCL 01/3

Steady potential flow nonlinear lifting surface theory is applied to an arbitrary helicopter rotor system in constant rotational and constant axial translational motion including hover. An unknown velocity doublet distribution is imposed on both the blade and wake surfaces, satisfying the normal boundary conditions on the true wetted surface and the Kutta condition at the trailing edge. The governing equation, then, becomes a Fredholm integral equation of the first kind. A numerical scheme is developed to solve the doublet strength distribution by approximating the surface with a finite number of uniformly loaded elements and satisfying the boundary conditions at their centroids. The integral equation is thereby transformed into a system of linear algebraic equations. The solution provides the velocity magnitude and direction, and the pressures on the blade surface. GRA

N76-17117 Thomson-CSF, Issy les Moulineaux (France). Groupe Optronique.
NEW ELECTRONIC DISPLAY SYSTEMS FOR AIRCRAFT INSTRUMENT PANELS [NOUVEAUX DISPOSITIFS DE VISUALISATION ELECTRONIQUE SUR PLANCHES DE BORD D'AVIONS]
M. Coussediere *In* AGARD Electron. Airborne Displays Dec. 1975 7 p In FRENCH (For availability see N76-17107 08-02)

N76-17338 European Space Agency, Paris (France).
ON THE SIMULATION OF AN UNDEREXPANDED PROPULSIVE JET WITH EXIT MACH NUMBER M EQUALS 2.50 FOR A FLIGHT VEHICLE IN SUPERSONIC FLOW FREE STREAM MACH 4.15 (ABRIGED VERSION)
Hans Emunds, Hansgeorg Riedel et al *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 114-122 Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 P 114-122 (For availability see N76-17332 08-34)

N76-17339 European Space Agency, Paris (France).
MUTUAL INTERFERENCE BETWEEN PROPULSIVE JETS AND INTERFERENCE WITH THE FUSELAGE, WING AND THE GROUND
Guenter Viehweger *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 123-165 refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen, DGLR, Cologne Report DLR-Mitt-74-18, 1974 p 123-165 (For availability see N76-17332 08-34)

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N76-17078*# Washington Univ., St. Louis, Mo. Dept. of Civil Engineering.
A STATE-OF-THE-ART REVIEW OF TRANSPORTATION SYSTEMS EVALUATION TECHNIQUES RELEVANT TO AIR TRANSPORTATION, VOLUME 1
Lonnie E. Haefner Aug. 1975 142 p refs 2 Vol. (Contract NAS2-8324) (NASA-CR-137770) Avail: NTIS HC $6.00 CSCL 01C

Mathematical and philosophical approaches are presented for evaluation and implementation of ground and air transportation systems. Basic decision processes are examined that are used for cost analyses and planning (i.e, statistical decision theory, linear and dynamic programming, optimization, game theory). The effects on the environment and the community that a transportation system may have are discussed and modelled. Algorithmic structures are examined and selected bibliographic annotations are included. Transportation dynamic models were developed. Citizen participation in transportation projects (i.e, in Maryland and Massachusetts) is discussed. The relevance of the modelling and evaluation approaches to air transportation (i.e, airport planning) is examined in a case study in St. Louis, Missouri. J.R.T.

N76-17079*# Washington Univ., St. Louis, Mo. Dept. of Civil Engineering.
DEVELOPMENT OF AIR TRANSPORTATION EVALUATION PROCESSES, VOLUME 2
Lonnie E. Haefner Aug. 1975 297 p refs 2 Vol. (Contract NAS2-8324) (NASA-CR-137771) Avail: NTIS HC $9.25 CSCL 01C

For abstract, see N76-17078.

N76-17080# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: GOLDEN WEST AIRLINES, INC., DE HAVILLAND DHC-6, N6383 AND CESSNAIR AVIATION, INC., CESSNA 150, N11421, WHITTIER, CALIFORNIA, JANUARY 9, 1975
7 Aug. 1975 24 p (PB-245583/0; NTSB-AAR-75-14; File-3-1941) Avail: NTIS HC $3.50 CSCL 01B

Golden West Airlines, Inc., Flight 261, a De Havilland Twin Otter, and a Cessnair Aviation, Inc., Cessna 150 collided in flight near Whittier, California. The accident occurred during daylight hours, at approximately 4:07 p.m., P.s.t., January 9, 1975. Both aircraft were destroyed by the collision and subsequent ground impact. The 10 passengers and 2 crewmembers on the Twin Otter, and the instructor pilot and student pilot of the Cessna 150 were killed. The National Transportation Safety Board determines that the probable cause of the accident was the failure of both flightcrews to see the other aircraft in sufficient time to initiate evasive action. GRA

N76-17081# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: MONTANA POWER COMPANY ROCKWELL TURBO COMMANDER 690A, N40MP AND USAF F-111A, 77-055 NEAR KINGSTON, UTAH, NOVEMBER 12, 1974
1 Aug. 1975 30 p (PB-245582/2; NTSB-AAR-75-12) Avail: NTIS HC $4.00 CSCL 01B

About 1804 m.s.t., on November 12, 1974, a United States Air Force (USAF)F-11'A, 77-055, and a Montana Power Company, Rockwell Turbo Commander, Model 690A, N40MP, collided in flight near Kingston, Utah. The F-111A was the lead aircraft in a formation of two F-111A's. The formation was attempting a rendezvous with a USAF KC-135 for night air refueling training when the planes collided. The pilot of N40MP, the sole occupant, was killed. The two crewmembers of the F-111A ejected successfully from their aircraft. Both aircraft were destroyed by the collision, the postcollision fire, and impact with the ground. The National Transportation Safety Board determines that the probable cause of this accident was the F-111A pilot's misidentification of the Turbo Commander as a refueling tanker with which he intended to rendezvous. Contributing to the misidentification was his failure to use prescribed procedures and techniques during rendezvous with a tanker aircraft for refueling. GRA

N76-17082# National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.
AIRCRAFT ACCIDENT REPORT: NORTHWEST AIRLINES, INC., BOEING 727-251, N26 4US, NEAR THIELLS, NEW YORK, DECEMBER 1, 1974
13 Aug. 1975 32 p (PB-245581/4; NTSB-AAR-75-8) Avail: NTIS HC $4.00 CSCL 01B

About 1926 e.s.t. on December 1, 1974, Northwest Airlines

Flight 6231, a Boeing 727-251, crashed about 3.2 nmi west of Thiells, New York. The accident occurred about 12 minutes after the flight had departed John F. Kennedy International Airport, Jamaica, New York, and while on a ferry flight to Buffalo, New York. Three crewmembers, the only persons aboard the aircraft, died in the crash. The aircraft was destroyed. The aircraft stalled at 24,800 feet m.s.l. and entered an uncontrolled spiralling descent into the ground. Throughout the stall and descent, the flightcrew did not recognize the actual condition of the aircraft and did not take the correct measures necessary to return the aircraft to level flight. Near 3,500 feet m.s.l., a large portion of the left horizontal stabilizer separated from the aircraft, which made control of the aircraft impossible. The National Transportation Safety Board determines that the probable cause of this accident was the loss of control of the aircraft because the flightcrew failed to recognize and correct the aircraft's high-angle-of-attack, low-speed stall and its descending spiral. GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications*.

N76-17083*# Ohio Univ., Athens. Avionics Engineering Center.
THE MINI-O, A DIGITAL SUPERHET, OR A TRULY LOW-COST OMEGA NAVIGATION RECEIVER
R. W. Burhans Nov. 1975 45 p refs
(Grant NGR-36-009-017)
(NASA-CR-144923; OU-TM-20(NASA)) Avail: NTIS HC $4.00 CSCL 17G

A quartz tuning fork filter circuit and some unique CMOS clock logic methods provide a very simple OMEGA-VLF receiver with true hyperbolic station pair phase difference outputs. An experimental system was implemented on a single battery-operated circuit board requiring only an external antenna preamplifier, and LOP output recorder. A bench evaluation and preliminary navigation tests indicate the technique is viable and can provide very low-cost OMEGA measurement systems. The method is promising for marine use with small boats in the present form, but might be implemented in conjunction with digital microprocessors for airborne navigation aids. Author

N76-17084# Continental Airlines, Inc., Los Angeles, Calif.
LORAN C CYCLE MATCHING OPERATIONAL EVALUATION IN NORTH PACIFIC AREA Final Report
Jon R. Hamilton Oct. 1975 70 p
(Contract DOT-FA75WA-3607)
(AD-A017749/3; FAA-RD-75-142) Avail: NTIS HC$5.00 CSCL 17/7

A Loran-C cycle matching receiver was evaluated during normal aircraft service as a potential replacement for Loran-A. The system was installed on a 727-100 aircraft and data were collected in the North Pacific area primarily between Honolulu and Guam. The program results indicate that Loran-C is a satisfactory substitute for Loran-A in the evaluation area. In most cases, the coverage was much more adequate than the Loran-A coverage. The Loran-C system under evaluation will require much less crew attention than the present Loran-A system. Author

N76-17085*# Ohio Univ., Athens. Avionics Engineering Center.
FLIGHT TEST OF 4-Hz AND 30-Hz OMEGA RECEIVER FRONT-END
Lee Wright Feb. 1976 18 p refs
(Grant NGR-36-009-107)
(NASA-CR-146383; Rept-21) Avail: NTIS HC $3.50 CSCL 17G

In-flight information was gathered on two Omega receiver analog modules, one having a 4-Hz bandwidth and the other a 30-Hz bandwidth. The Mini-O receiver was also monitored. An improved signal-to-noise characteristic of the narrower bandwidth front-end with negligible loss in dynamic range indicates that the 4-Hz front-end is the more desirable for the prototype Omega receivers. The Mini-O receiver was found to function quite satisfactorily on its second test flight, and has a very real potential for a low-cost, low-power, compact and light-weight Omega receiver. Author

N76-17086# Systems Control, Inc., Palo Alto, Calif. Champlain Technology Industries Div.
ECONOMIC IMPACT OF AREA NAVIGATION. VOLUME 1: MAIN TEXT Interim Report, Jul. 1973 - Jul. 1974
Eric H. Bolz, William H. Clark, Alan R. Stephenson, Walter Heine, and Harold L. Solomon Aug. 1975 105 p refs
(Contract DOT-FA72WA-3098)
(AD-A017385/6; FAA-RD-75-20-1-Vol-1) Avail: NTIS HC $5.50 CSCL 01/2

The results are presented of a preliminary analysis of the impact on user and ATC economics which would result from the implementation of area navigation in the National Airspace System. The study addresses both terminal area and enroute impact, and is concentrated on determining the effects on jet aircraft operations. The terminal area study includes the results of analyses of terminal area route structure designs, real time simulation of ATC controller performance and user effects, characteristics of the terminal structures, and costs and benefits of VNAV operations. The enroute study includes the results of analyses of enroute route structure designs, fast time simulation of traffic on these structures, resulting conflict situation effects on user impact and controller workload, and route length effects. User impact results are presented in the form of fuel and time increment benefits for several classes of users. ATC system impact results are presented in terms of controller communications productivity, airspace capacity effects and navigation standard requirements. Substantial economic benefits of RNAV are identified and presented. Further conclusions are presented indicating that both controllers and users can operate efficiently and safely in a mixed VOR/RNAV environment during the transition to RNAV, and that long term financial payoffs are available. Author

N76-17087# Systems Control, Inc., Palo Alto, Calif. Champlain Technology Industries Div.
ECONOMIC IMPACT OF AREA NAVIGATION. VOLUME 2: APPENDICES Interim Report, Jul. 1973 - Jul. 1974
Eric H. Bolz, William H. Clark, Alan R. Stephenson, Walter Heine, and Walter L. Solomon Aug. 1975 265 p
(Contract DOT-FA72WA-3098)
(AD-A017365/8; FAA-RD-75-20-2-Vol-2) Avail: NTIS HC $9.00 CSCL 01/2

Appendices are presented on the study methodology, terminal area aircraft performance data, aircraft performance categories, controller options and activity model, conflict resolution fuel and time penalties, conflict characterization, optimum cruise altitudes and performance data, fast time simulation results processing, enroute user benfit results, and airline benefits. M.J.S.

N76-17088# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
A TECHNIQUE FOR COMPENSATION OF KINEMATIC CONING DRIFT Technical Report, Jan. - Jun. 1975
Roy H. Setterlund Jun. 1975 56 p refs
(Contract F04701-74-C-0343)
(AD-A016774; R-895; SAMSO-TR-75-232) Avail: NTIS CSCL 17/7

This report documents a method developed to compensate for kinematic coning drift occurring in inertially stabilized platforms. Kinematic coning drift, which includes so-called rectified rotary vibration, is explained both mathematically and by way of example. The effects of servo bandwidth and the disturbance to inertia ratio on kinematic drift levels are investigated analytically and through computer simulation. The basic method of compensation developed uses platform gyro error signals to estimate angular changes in platform orientation. This estimate is used to recursively update a set of state variables which completely define the axis

about which the platform has drifted from its desired inertial orientation. From this, the platform to inertial direction cosine matrix may be constructed. GRA

N76-17089# Aerospace Guidance and Metrology Center, Newark Air Force Station, Ohio.
AGMC LCC MODEL FOR INERTIAL NAVIGATION SYSTEMS Final Report
Thomas D. Meitzler 1 Oct. 1975 72 p refs
(AD-A016626; AGMC-75-001) Avail: NTIS CSCL 17/7

The purpose of this report is to document a mathematical model currently being used to evaluate the potential life cycle costs of inertial navigation systems. This model has the capability of isolating and analyzing logistics start-up costs. It also allows for inertial system subassembly analysis. The report includes definitions of all input and output parameters, explanation of the equations, program listing with data deck description, and a sample run. Author (GRA)

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technoiogy.
For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

N76-17090*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A MATHEMATICAL MODEL OF AN ACTIVE CONTROL LANDING GEAR FOR LOAD CONTROL DURING IMPACT AND ROLL-OUT
John R. McGehee and Huey D. Carden Washington Feb. 1976 72 p refs
(NASA-TN-D-8080; L-10440) Avail: NTIS HC $4.50 CSCL 01C

A mathematical model of an active control landing gear (ACOLAG) was developed and programmed for operation on a digital computer. The mathematical model includes theoretical subsonic aerodynamics; first-mode wing bending and torsional characteristics; oleo-pneumatic shock strut with fit and binding friction; closed-loop, series-hydraulic control; empirical tire force-deflection characteristics; antiskid braking; and sinusoidal or random runway roughness. The mathematical model was used to compute the loads and motions for a simulated vertical drop test and a simulated landing impact of a conventional (passive) main landing gear designed for a 2268-kg (5000-lbm) class airplane. Computations were also made for a simply modified version of the passive gear including a series-hydraulic active control system. Comparison of computed results for the passive gear with experimental data shows that the active control landing gear analysis is valid for predicting the loads and motions of an airplane during a symmetrical landing. Computed results for the series-hydraulic active control in conjunction with the simply modified passive gear show that 20- to 30-percent reductions in wing force, relative to those occurring with the modified passive gear, can be obtained during the impact phase of the landing. These reductions in wing force could result in substantial increases in fatigue life of the structure. Author

N76-17091*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NEW POTENTIALS FOR CONVENTIONAL AIRCRAFT WHEN POWERED BY HYDROGEN-ENRICHED GASOLINE
Wesley A. Menard, Philip I. Moynihan, and Jack H. Rupe 15 Jan. 1976 29 p refs
(Contract NAS7-100)
(NASA-CR-145936) Avail: NTIS HC $4.00 CSCL 21D

Hydrogen enrichment for aircraft piston engines is studied. The feasibility is examined of inflight injection of hydrogen in general aviation aircraft engines to reduce fuel consumption and to lower emission levels. Results are summarized. Author

N76-17092# Advisory Group for Aerospace Research and Development, Paris (France).
SPECIALISTS MEETING ON STRUCTURAL DESIGN TECHNOLOGY
Nov. 1975 163 p refs partly in ENGLISH and FRENCH Presented at the 40th Meeting of the Struct. and Mater. Panel, Brussels, 13-18 Apr. 1975
(AGARD-CP-184) Avail: NTIS HC $6.75

The many problems of dynamics, aerodynamics and stress, which are involved in aircraft structural design, are discussed. For individual titles, see N76-17093 through N76-17100.

N76-17093 Hawker Siddeley Aviation Ltd., Woodford (England).
THE SIGNIFICANCE OF VARIOUS MANAGEMENT AND TECHNICAL TECHNIQUES ON AIRCRAFT STRUCTURAL DESIGN
Alan James Troughton *In* AGARD Specialists Meeting on Structural Design Technology Nov. 1975 16 p refs (For availability see N76-17092 08-05)

Techniques are summarized which are used in aircraft structural design. The in-service performance of aircraft as regards structural accidents and incidents is given together with typical costs for R&D structural activities. All aircraft structural design techniques are reviewed including stressing, detail design, computer aided design and alternative methods of testing. The use of value engineering in obtaining optimum cost aircraft is discussed. Author

N76-17094 Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
EVOLUTION OF THE ROLE PLAYED BY THE STRESS ANALYSIS OFFICE IN THE DESIGN OF A PROTOTYPE [EVOLUTION DU ROLE DU BUREAU DES STRUCTURES DANS LA REALISATION D'UN PROTOTYPE]
Marcel Peyrony *In* AGARD Specialists Meeting on Structural Design Technology Nov. 1975 8 p In FRENCH (For availability see N76-17092 08-05)

Changes that have taken place in the work organization of the stress analysis and aircraft structures design office during the last few years due to the introduction of computer techniques were reviewed. The relative advantages and disadvantages of plotters and interactive graphics terminals were summarized. A number of computer programs used in the design of representative aircraft structures and elements were mentioned. Problems related to computer running time and the inputting and retrieval of data into and from computers were described. Applications to the Mercure and Falcon 50 aircraft were mentioned and illustrated. Transl. by Y.J.A.

N76-17095 Westland Helicopters, Ltd., Yeovil (England).
THE STRUCTURAL DESIGN PROCESS FOR HELICOPTERS WITH EMPHASIS ON THE ROTOR
D. A. S. Howell *In* AGARD Specialists Meeting on Structural Design Technology Nov. 1975 18 p ref (For availability see N76-17092 08-05)

The helicopter structural designer must develop an awareness of many potential design problems not encountered in the fixed wing field. The solution of these problems invariably involves the three disciplines of dynamics, aerodynamics and stress, and is further complicated by the increasingly stringent demands of the overall performance requirements. These particular aspects of helicopter design as well as the design process are introduced by the paper, which also considers the role of the structural designer during the development phase of the helicopter. The development of new analytical and experimental techniques, the application of new materials, and some structural design objectives are also presented with a view to enhancing further the capabilities of the helicopter. Author

N76-17096 Technische Hogeschool, Delft (Netherlands).
THE PROBLEMS ASSOCIATED WITH INTERNATIONAL DESIGN TEAMS AND THEIR SOLUTIONS
E. J. VanBeek *In* AGARD Specialists Meeting on Structural Design Technology Nov. 1975 4 p (For availability see N76-17092 08-05)

Some problems relating to international cooperation in design of aircraft and possible solutions for these problems are discussed. The strong identity of experienced design organizations, based on tradition and a long history, initially results in many difficulties and differences of opinion, before a smoothly running cooperation has been achieved. Other important factors are variations in the drawing numbering systems, affecting the modification system

used during the design phase and thereafter. There are the problems related to normalization and standardization of standard parts, and there is still a large variation in national material specifications for basically the same material. Variations in the national airworthiness requirements resulting in special conditions are an important feature in multi-national design cooperation.
Author

N76-17097 Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
THE INTRODUCTION OF NEW MATERIALS
V. V. Tein and P. Selvaggi (Aeritalia, Turin) *In* AGARD Specialists Meeting on Structural Design Technology Nov. 1975 21 p refs (For availability see N76-17092 08-05)

Besides a discussion of the state of the art concerning materials, a summary is presented about work with new materials at AERITALIA and Messershmitt-Boelkow-Blohm. Special attention is given to materials for fighter aircraft structures.
Author

N76-17098 General Dynamics/Fort Worth, Tex.
THE ROLES OF ANALYSIS IN RELATION TO STRUCTURAL TESTING
William C. Dietz and Lawrence C. Seth *In* AGARD Specialists Meeting on Structural Design Technology Nov. 1975 14 p (For availability see N76-17092 08-05)

The relationship between analysis and test is explained for a typical modern fighter aircraft. The role each plays as a part of the total structural certification program is emphasized for each element of the structural design process. These include the efforts involved in development of basic allowable stresses for design, wind tunnel testing, loads and stress analysis, full scale test, and flight test. Currently used methods and procedures for solution of recent problems in achieving economically durable airframe structure and the approach to the application of composites are reviewed.
Author

N76-17099 British Aircraft Corp., Preston (England). Military Aircraft Div.
THE USE OF COMPUTERS TO DEFINE MILITARY AIRCRAFT STRUCTURES
I. C. Taig *In* AGARD Specialists Meeting on Structural Design Technology Nov. 1975 32 p refs (For availability see N76-17092 08-05)

The use of the computer as a tool to aid structural design has become firmly established during the last twenty years. In particular, it is probably true that in no other area of computer operation has greater progress been made than in structural analysis. The present state of the art in the related use of computers is surveyed and benefits and penalties which result therefrom are discussed.
Author

N76-17100 McDonnell Aircraft Co., St. Louis, Mo.
WEIGHT CONTROL AND THE INFLUENCE OF MANUFACTURING ON STRUCTURAL DESIGN
R. C. Goran *In* AGARD Specialists Meeting on Structural Design Technology Nov. 1975 16 p (For availability see N76-17092 08-05)

Practices of weight control and the influence of manufacturing on structural design are discussed for the F-4 series of aircraft, the F-15 air superiority aircraft, and the DC-10 wing for commercial aircraft. Many of the problems are a result of the constant need to design efficient lighter weight structures by the introduction of new materials, configurations, and joining methods, together with closer tolerances. To some extent, optimum design and minimum manufacturing cost appear divergent in nature. Much of the interaction between design and manufacturing is to compromise or seek acceptance for seemingly conflicting requirements.
Author

N76-17101*# Lockheed-California Co., Burbank.
MINIMUM ENERGY, LIQUID HYDROGEN SUPERSONIC CRUISE VEHICLE STUDY Final Report, 21 Apr. - 17 Oct. 1975
G. D. Brewer and R. E. Morris Oct. 1975 178 p refs
(Contract NAS2-8781)
(NASA-CR-137776; LR-27347) Avail: NTIS HC $7.50 CSCL 01C

The potential was examined of hydrogen-fueled supersonic vehicles designed for cruise at Mach 2.7 and at Mach 2.2. The aerodynamic, weight, and propulsion characteristics of a previously established design of a LH2 fueled, Mach 2.7 supersonic cruise vehicle (SCV) were critically reviewed and updated. The design of a Mach 2.2 SCV was established on a corresponding basis. These baseline designs were then studied to determine the potential of minimizing energy expenditure in performing their design mission, and to explore the effect of fuel price and noise restriction on their design and operating performance. The baseline designs of LH2 fueled aircraft were than compared with equivalent designs of jet A (conventional hydrocarbon) fueled SCV's. Use of liquid hydrogen for fuel for the subject aircraft provides significant advantages in performance, cost, noise, pollution, sonic boom, and energy utilization.
Author

N76-17102# Bell Helicopter Co., Fort Worth, Tex.
DYNAMIC TESTING OF A COMPOSITE MATERIAL HELICOPTER TRANSMISSION HOUSING
Roy A. Battles Sep. 1975 81 p refs
(Contract DAAJ02-73-C-0038; DA Proj. 1F1-62208-A-170)
(AD-A015521; BHC-299-099-743; USAAMRDL-TR-75-47)
Avail: NTIS CSCL 13/9

The program was carried out to investigate the integration of a GFE composite material gear housing into a UH-1 bench test transmission. The composite material housing was designed to replace a conventional magnesium sand cast housing. A test program using the composite housing was outlined to: (1) investigate tooling parameters and finish machine a housing; (2) determine the coefficients of thermal expansion and thermal conductivity; (3) conduct a spiral bevel gear development test; (4) thermal map a transmission; (5) conduct a 50-hour overpower test; and (6) conduct a fail-safe test.
GRA

N76-17103# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
ANALYSIS OF AIRCRAFT EVASION STRATEGIES IN AIR-TO-AIR MISSILE EFFECTIVENESS MODELS
G. Carpenter and M. Falco Aug. 1975 85 p refs
(AD-A015238; RE-506) Avail: NTIS CSCL 16/2

This report presents a new methodology with which to quantify missile effectiveness and aircraft vulnerability. The approach is a blend of applications of optimal control theory, stochastic learning theory, and simulation. This methodology permits an evaluation of aircraft evasive maneuvering and countermeasures deployment strategy as an integral part of the effectiveness/vulnerability measurements. The strategy determination is a form of feedback control policy based upon a discretized set of information thresholds in the relative coordinate space as would be available to an evading aircraft pilot. The optimization criteria of an evading aircraft is that of maximizing the survival probability for all relative coordinates. The representative model chosen for illustration is evasion from a close range air-to-air IR guided missile.
GRA

N76-17104# Army Aviation Systems Command, St. Louis, Mo.
Interim Report, Oct. 1969 - May 1974
MAJOR ITEM SPECIAL STUDY (MISS), OH-58A MAIN TRANSMISSION ASSEMBLY FSN 1615-121-6543 PN 206-040-003-5
Sep. 1975 23 p
(AD-A015506; USAAVSCOM-TR-75-35) Avail: NTIS CSCL 01/3

The report is designed to illustrate how cost savings can result by analyzing reported removal data from fielded Army aircraft. Certain equipment, because of finite life, high cost, or need for intensive management, is classified as reportable for control purposes on the DA Form 2410. The MISS report investigates these components for possible cost savings based upon total elimination of selected failure modes. These modes are chosen because of the percentage of failures they represent and they appear to be feasible Product Improvement Program candidates.
GRA

N76-17105# Boeing Aerospace Co., Seattle, Wash.
COCKPIT SWITCHING STUDY, PHASE 3: TECHNOLOGY AND INTERFACE REQUIREMENTS FOR MULTIFUNCTION SWITCHING/DISPLAY SYSTEMS Annual Technical Report,

15 May 1974 - 31 Mar. 1975
David K. Graham and W. Gordon Broomhead Jun. 1975 258 p refs
(Contract N00014-72-C-0191; NR Proj. 213-088)
(AD-A015301; D180-18732-1; JANAIR-750601) Avail: NTIS CSCL 01/3

The primary objectives of this study were (1) identification of technology requirements for a multifunction control/display system, and (2) determination of hardware and software interface requirements for a multifunction control/display system. Technology requirements are identified in three areas, (1) research requirements, (2) functional requirements, and (3) hardware requirements. The report also includes a discussion of terminology associated with, and a definition of, the multifunction switching concept. GRA

N76-17106# LTV Aerospace Corp., Dallas, Tex. Vought Systems Div.
S-3A GRAPHITE/EPOXY SPOILER FABRICATION FOR FLIGHT EVALUATION Final Report, 21 Jun. 1974 - 21 Mar. 1975
O. E. Dhonau, E. G. Blosser, B. V. Bryant, G. Bourland, and S. A. McGovern Mar. 1975 94 p
(Contract N62269-74-C-0629)
(AD-A016660; NADC-75217-30) Avail: NTIS CSCL 13/9

The program was initiated in June 1974 to revise the design and produce for flight evaluation 4 ship sets of graphite epoxy lower left hand and right hand spoilers for the S-3A aircraft. Design changes were required to provide installative instructions and to provide a production, trailing edge seal installation. A left hand tool was available from the previous program, but a right hand tool had to be fabricated. Several manufacturing improvements were introduced to reduce manhours per part in the fabrication operations. The tools were reworked and prepared for use, but in the checkout stage were found to leak air in excess of the specification tolerance. After repeated unsuccessful attempts at sealing, the problem was circumvented by a double bagging technique for autoclave curing in order to meet the completion schedule. Extra manhours per part were required and were accounted for in the cost accumulation. GRA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N76-17107# Advisory Group for Aerospace Research and Development, Paris (France).
ELECTRONIC AIRBORNE DISPLAYS
Dec. 1975 430 p refs In ENGLISH and FRENCH Presented at the Avionics Panel Symp., Edinburgh, 7-11 Apr. 1975
(AGARD-CP-167) Avail: NTIS HC $11.75

Problems of airborne displays were considered. Reports in the following areas were presented: trends in the field of airborne displays, evaluation and assessment procedures for airborne display systems, display devices and materials, data processing, and displays for particular applications. For individual titles, see N76-17108 through N76-17140.

N76-17108 Thomson-CSF, Malakoff (France). Div. des Equipements Avioniques.
THE IMPACT OF MODERN ELECTRONIC AIRBORNE DISPLAYS IN FUTURE AVIATION
Y. Brault *In* AGARD Electron. Airborne Displays Dec. 1975 8 p In FRENCH (For availability see N76-17107 08-06)

The expected impact of modern electronic airborne display systems on future aircraft was presented, with emphasis on the need to improve man-machine interactions, especially in military aviation. The need is imposed by the following factors: (1) the setting of more and more complex operational flying missions, (2) the introduction of aircraft (interceptors, fixed and rotating wing attack models) with ever higher performance, (3) the introduction of more and more diversified weapon systems, (4) the existence of an extremely lethal and complex environment. Future applications to civil aviation were also briefly mentioned. Transl. by Y.J.A.

N76-17109 Marconi-Elliott Avionic Systems Ltd., Rochester (England).
TRENDS IN TECHNOLOGY IN AIRBORNE ELECTRONIC DISPLAYS
P. A. Hearne *In* AGARD Electron. Airborne Displays Dec. 1975 16 p (For availability see N76-17107 08-06)

The increasing complexities and capabilities of flight instruments are discussed with emphasis on future display technology. Cathode ray tube and solid state displays are examined along with the organization of the displays for providing an integrated electronic system. F.O.S.

N76-17110 Smiths Industries Ltd., Bishops Cleeve (England). Advanced Displays Studies Group.
PERFORMANCE REQUIREMENTS FOR AIRBORNE MULTIFUNCTION DISPLAY SYSTEMS
G. Mann *In* AGARD Electron. Airborne Displays Dec. 1975 6 p refs (For availability see N76-17107 08-06)

Any airborne multifunction display must by definition be capable of presenting information from a variety of sensors and data sources. Some of these sensors and their critical parameters are briefly considered in relation to their display requirments. The multifunction display may need to be compatible with any such sensor or source and also with computer generated symbology derived from instrumentation sensors and weapon systems. The input sources which appear to require the highest performance from airborne displays are those of the current and future image forming sensors. There is a danger that many systems using multifunction displays could be display limited unless the complex interaction between sensor, display and observer is understood. Author

N76-17111 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
COMPARISON OF CONVENTIONAL AND ADVANCED AIRCRAFT DISPLAYS
Ralf Beyer (Techn. Univ., Brunswick) *In* AGARD Electron. Airborne Displays Dec. 1975 7 p refs (For availability see N76-17107 08-06)

The comparison of conventional and advanced aircraft displays often requires a discrimination of two sample means of pilot's performance and workload measures for a limited sample size, a postulated minimum difference of means and a given error probability. Under these conditions significant results may be obtained only if the population variance does not exceed a certain limit. Some major sources of variability and their influence on the significance of experimental results are discussed. Furthermore two different philosophies of evaluation of displays are presented as well as some experiences with pilot's performance and workload measures employed in flight simulator and inflight investigations of displays. Author

N76-17112 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
EFFICIENT ASSESSMENT AND OPTIMIZATION OF DISPLAY LAYOUT BY CONTINUOUS TACHISTOSCOPY
Josef Thomas and Ulrich Stolzke *In* AGARD Electron. Airborne Displays Dec. 1975 12 p refs (For availability see N76-17107 08-06)

The method of continuous tachistoscopy and its benefits in the design process of electronic airborne display layout are described. A typical application in the field of advanced monitor displays is presented. The results of this experiment show the suitability of the proposed investigation method for a straightforward assessment and optimization of complex display arrangements in simulator tests, herewith contributing to a considerable reduction of expensive inflight testing. Author

N76-17113 Thomson-CSF, Paris (France). Groupement Tubes Electroniques.
COLOR AND BRIGHTNESS REQUIREMENTS FOR COCKPIT DISPLAYS PROPOSAL TO EVALUATE THEIR CHARACTERISTICS
J. P. Galves and J. Brun *In* AGARD Electron. Airborne Displays

Dec. 1975 8 p refs In FRENCH; ENGLISH summary (For availability see N76-17107 08-06)

Introduction of color coding for information displays added several qualities to the already existing monochromatic electronic aircraft display. The information density to be displayed is increased, and the data acquisition time and the error possibilities are reduced. These advantages are fundamental in order to display graphic and numerical informations and lighted areas for jet plane flights control (map display, hud). These informations have to be detected by the pilot for every surround illumination level. An experimental work schedule, associating brightness and chrominance measurements on one hand, and visual perception of operators on the other, permitted to separate different parameters and to formulate several definitions about brightness and color contrast, the interaction between these two parameters and their measuring conditions. 'Detection Index' and 'Discrimination Index' notions are introduced. These parameters can be measured and permit to easyly evaluate the display quality for every background and surround illumination Minimum index values are proposed for a confortable detection and identification of standard symbols especially in the case of direct sunlight on the displaying board. Color display used is a color CRT with a penetration screen developed by THOMSON-CSF for 'Head down' and 'Head up' display. Definition and standard introduced can be applied to every color or monochromatic display such as plasma panel, liquid crystals, LED or any electromechanical devices. Author

N76-17114 Ferranti, Ltd., Edinburgh (Scotland).
INTEGRATED MULTI-FUNCTION COCKPIT DISPLAY SYSTEMS
J. M. Braid *In* AGARD Electron. Airborne Displays Dec. 1975 13 p refs (For availability see N76-17107 08-06)

The multifunction display concept and the necessity for its efficient integration to meet the more demanding future tasks are defined briefly. Attention is drawn to the potential shortcomings of past arrangements, particularly in the pilot's cockpit. The different data sources and sensors, categories of airborne display, display devices and types of drive signals are described and reference is made to their compatibility. Particular mention is made of cursive, raster and cursive-on-raster writing. An example is given of how the various elements in the system can be integrated with integrity, into a system which permits more attention to be paid to the achievement of a satisfactory man-machine interface, without compromising individual sensor performance. Diagrams and photographs demonstrate the feasibility of the concept and compatibility of the hardware within the cockpit constraints. Pitfalls facing the implementation of such a system are included and the probable areas of conflict and reward are established. Author

N76-17115 Royal Aircraft Establishment, Farnborough (England). Space Dept.
THE USE OF MODERN LIGHT EMITTING DISPLAYS IN THE HIGH ILLUMINANCE CONDITIONS OF AIRCRAFT COCKPITS
Brian Ellis and John Wharf *In* AGARD Electron. Airborne Displays Dec. 1975 11 p refs (For availability see N76-17107 08-06)

A 3 mm high LED display was tested in 80,000 lux. Further tests on the format and color of small matrix displays are also described. It was found that red displays are more legible than green in 10,000 lux. A number of other aspects of the perception of light emitting displays in high illuminance were also examined. Author

N76-17116 Transportation Systems Center, Cambridge, Mass.
AN EXPERIMENTAL EVALUATION OF VARIOUS ELECTRONIC COCKPIT DISPLAYS FOR AIR/GROUND DATA LINK COMMUNICATIONS
R. W. Wisleder, J. F. Canniff, and E. H. Hilborn *In* AGARD Electron. Airborne Displays Dec. 1975 34 p refs (For availability see N76-17107 08-06)

A series of laboratory and cockpit simulator experiments was conducted by the Department of Transportation, Transportation Systems Center in a study of the human factors aspects of a cockpit digital data link system for air traffic control (ATC) and airline company business communications. The laboratory experiments utilized photographic slides to study message formatting. The simulator experiments evaluated visual displays, computer generated synthetic speech and pilot input devices. The potential of data link for reducing pilot workload and channel congestion while providing efficient communications in a highly automated ATC system is of great interest to the Federal Aviation Administration. The experimental results to date led to the recommendation of a 16-character short message display, development of some guidelines for abbreviating and formatting messages, and the conclusion that pilots can effectively communicate using visual displays, synthetic speech, and pushbutton keysets, with an overall reduction in workload. Author

N76-17117 Thomson-CSF, Issy les Moulineaux (France). Groupe Optronique.
NEW ELECTRONIC DISPLAY SYSTEMS FOR AIRCRAFT INSTRUMENT PANELS [NOUVEAUX DISPOSITIFS DE VISUALISATION ELECTRONIQUE SUR PLANCHES DE BORD D'AVIONS]
M. Coussediere *In* AGARD Electron. Airborne Displays Dec. 1975 7 p In FRENCH (For availability see N76-17107 08-02)

Concepts for new electronic display systems for aircraft instrument panels were proposed, emphasizing the need to integrate and synthesize the information presently given by a number of different instruments. These new systems can either take the form of 'head-up' or 'head-down' display devices depending on the type and phase of each flight or mission. Such systems would present the following advantages: (1) presentation of more information in less space, (2) presentation of the information that is only required during a specific flight or mission situation, (3) greater flexibility and large information carrying capacity, (4) presentation of the instantaneous position of the aircraft and prediction of its future flight path. The hardware used in the construction of these display systems could either be based on the present state of the art and include multicolored CRT's, or could include new techniques now under study such as plasmas or liquid crystals. Transl. by Y.J.A.

N76-17118 Ferranti, Ltd., Oldham (England).
CRT'S FOR ELECTRONIC AIRBORNE DISPLAYS
M. R. Bennett *In* AGARD Electron. Airborne Displays Dec. 1975 13 p refs (For availability see N76-17107 08-06)

The two CRT display systems currently under development are described. The first is a packaged 178 x 127mm head down display (HDD) CRT. The design concept and subsequent selection of the various alternative parameters which were available at the start of the development are described. Each parameter is taken separately and the analysis and subsequent results are described. Full details are given of a final package design currently nearing completion which is intended to be fitted into a Hawker Hunter aircraft of RAE Farnborough for flight trails to evaluate the performance under real direct sunlight and sunlit cloud conditions. The prime design consideration for this CRT was the combination of a suitable contrast enhancement technique together with the best currently available phosphor for operation at high brightness levels. The second CRT package described was again developed using a number of individual steps to optimize the design for a particular application. In this case the application was for a helmet mounted head up display (HMHUD) CRT. Reduced weight and size were necessary in order to harmonize with the current helmet display concepts. This CRT was based on a commercial tube 02B/97D2Kh and the VX1776 designs which preceded it. The individual parameters are analyzed separately. Author

N76-17119 Thomson-CSF, Paris (France). Groupement Tubes Electroniques.
COLOR HEAD DOWN AND HEAD UP CRT'S FOR COCKPIT DISPLAYS
A. Martin and J. Brun *In* AGARD Electron. Airborne Displays Dec. 1975 8 p In FRENCH; ENGLISH summary (For availability see N76-17107 08-06)

Important development work, during several years, led to the use of color CRT in cockpit displays. The characteristics of these tubes and their behavior in airplanes are discussed. A separate program allowed the measurement of illumination range found during flight, for determining visibility conditions of instrument boards from complete darkness to sunlight illuminance. A simulator was built which reconstitutes the lighting conditions.

Color display, incorporating color CRT, allowing simultaneous presentation of symbols in several colors, luminance and shape were tested. Measurements of detection index, as described in another lecture, were carried on to evaluate conditions of perfectly confortable vision and conditions of 100% accuracy indication of color symbols displayed by color CRT. A 7 inch diagonal rectangular color CRT THX613-E17, meeting these specifications was developed for head down utilization. The tube incorporates a penetration screen displaying red at 10 kV, amber at 13 kV and green at 17 kV. The electron gun was designed to face beam intensity requirements at all colors and symbol luminances. An electrostatic focusing with zero current need, with focus voltage linearly dependent of screen voltage just requests single high voltage power supply for tube drive. The CRT is ruggedized and double heater gun has been adapted in order to increase reliability. Under sunlight illumination (7,000 fc), detection index over 1 were achieved, and detection index over 2 allowing very confortable vision were obtained in other less stringent conditions. Author

N76-17120 Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Flight Deck Development Branch.
SOLID STATE FLIGHT INSTRUMENT DEVELOPMENT
Wayne R. Clements *In* AGARD Electron. Airborne Displays Dec. 1975 4 p (For availability see N76-17107 08-06)

An Air Force Advanced Development Program is investigating the applicability of dot matrix displays for flight control instrumentation. Program goals include flat panel design, digital addressability, format flexibility and multi-function operability. Validation of the technology was reported and addressed the areas of technology selection and fabrication techniques, optical contrast enhancement filtering, and dot matrix standards for legibility and design. The light emitting diode (LED) technology was selected as it fulfilled program objectives and did not require a research breakthrough prior to application. Fabrication techniques were demonstrated and are within the realm of a high volume production method. Acceptable contrast enhancement via filtering resulted from the combination of a circular polarizer, band pass element, and antireflective coatings. A contrast ratio of 6:1 under the high ambient condition, i.e., 10,000 foot candles (fc), can be achieved. Human factors studies showed little, if any, performance differences between the display of punctate and continuous symbology. Author

N76-17121 Royal Radar Establishment, Malvern (England).
LIQUID CRYSTAL DISPLAY DEVICES
E. P. Raynes *In* AGARD Electron. Airborne Displays Dec. 1975 14 p refs (For availability see N76-17107 08-06)

Liquid crystals enable low voltage (approximately 3 volt) low power (approximately 1 micro-W) displays to be made which are readable in high ambient light level and can be as large as 30 cms by 30 cms. After a brief introduction to the liquid crystalline state, the basis and the operation are described of the twisted nematic effect, which has become the most widely used liquid crystal electro-optic effect. Basic device construction is also reviewed. The origin of patches of different contrast in these devices is discussed together with methods of eliminating them to produce devices with uniform contrast. Considerable progress has been made since the invention of the cyanobiphenyls in producing stable, colorless, low viscosity liquid crystals usable over the temperature range of -10 to +60 C. This progress is reviewed. The problems encountered with the extended temperature range required for cockpit displays and the displaying of complex alpha-numeric information is examined. Author

N76-17122 Royal Radar Establishment, Malvern (England).
MULTICOLOUR DISPLAYS USING A LIQUID CRYSTAL COLOUR SWITCH
Ian A. Shanks *In* AGARD Electron. Airborne Displays Dec. 1975 11 p refs (For availability see N76-17107 08-06)

The conversion of a monochrome CRT display to a two color frame sequential display was demonstrated using a flat liquid crystal electro-optical color switch. The use of a similar device as a polarization switch permitted the production of a frame sequential stereoscopic CRT display which may be monochrome or color. Switching speeds of 1 msec at repetition rates up to 40 Hz are achieved by using an appropriate two frequency drive to the liquid crystal cell. This is sufficiently fast to meet frame sequential requirements. The construction, properties and performance of these devices are described and their advantages and limitations are discussed in relation to cockpit displays and other military applications. Author

N76-17123 Services Electronics Research Lab., Baldock (England).
ELECTRONICALLY-CONTROLLED LIQUID-CRYSTAL GRATICULES FOR USE IN OPTICAL SYSTEMS
C. H. Gooch and R. C. Bottomley *In* AGARD Electron. Airborne Displays Dec. 1975 8 p refs (For availability see N76-17107 08-06)

In a number of optical systems there is a requirement for a graticule whose position in the field of view can be controlled electronically. This may be achieved by a liquid crystal device addressed by MOS circuits built onto the display. The device described gives a graticule display of 400 x 150 lines and achieves a resolution of 10 lines/mm. Author

N76-17124 Sperry Rand Corp., Phoenix, Ariz.
RECENT HARDWARE DEVELOPMENTS FOR ELECTRONIC DISPLAY SYSTEMS FOR US MILITARY AIRCRAFT
Richard A. Wallace *In* AGARD Electron. Airborne Displays Dec. 1975 12 p (For availability see N76-17107 08-06)

The hardware design tradeoffs required to meet the varied requirements of several CRT cockpit display systems are discussed. The multimode display systems use both stroke and raster techniques to present varied formats of data from radar, TV, IR, attitude, fire control, flight director, and other aircraft systems. These display requirements are translated into CRT, phosphor-filter, high voltage, video, deflection, and symbol generator requirements. Power and thermal considerations are emphasized as a primary factor in various tradeoff studies. Digital symbol generation is examined in terms of hardware functional, speed, and memory size requirements. Author

N76-17125 Royal Radar Establishment, Malvern (England).
DIGITAL SCAN CONVERSION TECHNIQUES
T. Snowball and T. R. Berry *In* AGARD Electron. Airborne Displays Dec. 1975 19 p refs (For availability see N76-17107 08-06)

The Digital Semiconductor Scan Converter, and the factors determining the storage capacity required are discussed in terms of sensor and display CRT resolution, picture texture and observer acuity. A versatile experimental digital scan converter with a one megabit storage capacity, having various modes of store organization and display presentation is described. Author

N76-17126 Royal Radar Establishment, Malvern (England).
POLAR TO CARTESIAN AXIS-TRANSFORMING DIGITAL SCAN CONVERTERS
T. R. Berry and T. Snowball *In* AGARD Electron. Airborne Displays Dec. 1975 25 p ref (For availability see N76-17107 08-06)

Ways in which digital scan converters can improve on conventional radar display formats are examined and how a display can be extended to give presentations not previously available is shown. The major limitations of scan converters based on shift registers are discussed, in particular where such converters are required to transform polar radar formats to rectilinear TV. It is then shown how the introduction of the fast semi-conductor random access Memory (RAM) has made the axis-transformation problem a relatively straightforward hardware implementation of conventional axis-conversion formulae. Special display and conversion problems associated with moving platform systems are outlined, and techniques for applying motional stabilization to the converter to facilitate scan to scan integration discussed. The organization of such ground stabilized converters to provide a choice of ground or platform stabilized displays are then described. Finally, the limitations of a simple system based on a single picture point update per store word access (spot at a time transfer) is considered, and a more complex organization which allows for more than one spot to be updated at a time is outlined. Author

N76-17127 Hughes Aircraft Co., Culver City, Calif.
DIGITAL SCAN CONVERTERS IN AIRBORNE DISPLAY SYSTEMS

G. K. Slocum and J. O. Mysing (AFAL) *In* AGARD Electron. Airborne Displays Dec. 1975 18 p (For availability see N76-17107 08-06)

Recent developments in digital scan converters (DSC) provide high quality image storage for avionics sensor displays and can simplify the pilot's tasks in radar target acquisition. Typical digital scan converter concepts and their system design implications are described for an air-to-air radar, a multimode radar and a high resolution reconnaissance sensor. Studies of operator performance in using stored digital imagery with various encoded gray levels show eight shades of gray are adequate for radar imagery but at least 16 are needed for electro-optical imagery. Tradeoffs in memory selection and digital image enhancement techniques are presented. The cost of ownership analysis shows that the high reliability, low maintenance adjustments and short repair time of digital scan converters can result in significant life cycle cost savings over analog scan converter display systems. Author

N76-17128 Marconi-Elliott Avionic Systems Ltd., Rochester (England).

ECONOMIC SCAN CONVERSION TECHNIQUES FOR INTEGRATED AVIONIC SYSTEMS

G. C. Bull and G. M. Barling *In* AGARD Electron. Airborne Displays Dec. 1975 8 p (For availability see N76-17107 08-06)

Modern cockpit display systems are making increasing use of TV raster techniques to provide a common signal format for a wide range of differing types of computed and sensor data. A principal feature of such systems is the necessary scan conversion units which should provide accurate translation of data and video picture inputs into the common raster display base. Earlier double ended scan conversion tubes have been found to have almost unacceptable problems in terms of accuracy, dynamic range and picture registration. A new technique using a tube scan converter of the single electron gun type avoids many of the problems of the earlier double ended type and permits the conversion of high resolution video pictures without the relatively high costs of the large memory requirements of equivalent digital scan converters. When however the conversion picture subject is limited in size, a new digital technique has considerably reduced the memory requirements compared with those necessary for video picture conversion. By relating the scan conversion technique to the particular task in hand, it appears probable that the cost of future scan converters can be reduced to a small proportion of the overall display system cost. Author

N76-17129 Draper (Charles Stark) Lab., Inc., Cambridge, Mass.

DISPLAY GENERATOR INSTRUCTION SET CONSIDERATIONS FOR AEROSPACE APPLICATION

Ivan S. Johnson and Stephen K. Holford *In* AGARD Electron. Airborne Displays Dec. 1975 11 p refs (For availability see N76-17107 08-06)

A tradeoff study to determine desirable characteristics in a display processor for an aerospace (space shuttle) application is reported. The assumed display device is a conventional CRT. The tradeoffs involved in specifying which instructions should be implemented in the display processor's hardware repertoire are presented. The importance of such a tradeoff focuses primarily upon the resultant software costs (size, speed of execution, time to write and de-bug) incurred as a function of whether certain instructions are implemented in the processor hardware. Other factors are size, weight; reliability, processor/display unit speed relationships, and memory implications. The tradeoff study of possible graphics capability includes most of the instructions that an aerospace display generation scheme would be confronted with - including vectors, alpha-numerics, beam control instructions (e.g., blinking, dash lines, line width, etc.) index branch, subroutine call and return, compare and skip, rotation, windowing, and special items like moving tape meter. Author

N76-17130 EMI Electronics Ltd., Hayes (England).

INTEGRATION ALGORITHM IN A DIGITAL DISPLAY STORE FOR AIRBORNE SURVEILLANCE RADAR

V. B. Hulme *In* AGARD Electron. Airborne Displays Dec. 1975 27 p refs (For availability see N76-17107 08-06)

A search for optimum integration algorithms in a multicell digital display processor for airborne surveillance and search radar is discussed. Markovian statistics are applied to evaluate performance in terms of probabilities of detection and false alarm. Results are illustrated by probability graphs characterizing the alternatives examined and a selected range of parameters. The best are ranked in order of false alarm/detection probability ratio referred to the input, for a standard performance. It is concluded that algorithms employing a simple regular decrement are superior to proportional decrement algorithms or sum and dump integrators. Author

N76-17131 Air Force Avionics Lab., Wright-Patterson AFB, Ohio.

THE DAIS DESIGN AND SYSTEM INTEGRATION ASPECTS OF ELECTRONIC AIRBORNE CONTROLS AND DISPLAYS

Nicholas A. Kopchick and S. Joel Premselaar (Raedan Assoc., Inc.) *In* AGARD Electron. Airborne Displays Dec. 1975 20 p refs (For availability see N76-17107 08-06)

The Digital Avionics Information System (DAIS) encompasses the maximum utilization of electronic airborne controls and displays to present to the pilot all pertinent and timely information necessary for both normal and degraded mission operations. The salient features include a description of the DAIS: (1) operational and system requirements, (2) control/display subsystem configuration and functional operation, and (3) system and subsystem life-cycle cost considerations. Through the increased use of common digital avionic equipments and software modules, an effort is being made in this program to directly attack the problem of rising life-cycle costs while, at the same time, maintaining or increasing given performance levels. Results of recent DAIS design studies and system analyses, based on typical close air support and air superiority missions, conducted by the Air Force Avionics Laboratory are presented. Author

N76-17132 Marconi-Elliott Avionic Systems Ltd., Rochester (England). Airborne Display Div.

THE TYPE 664 HUD WEAPON AIMING SYSTEM

J. R. Machin *In* AGARD Electron. Airborne Displays Dec. 1975 10 p ref (For availability see N76-17107 08-06)

Head up display systems incorporating general purpose digital computers are now in wide scale operational service and their effectiveness and reliability have been demonstrated in over 1,000,000 flying hours. Later developments of this type of system have expanded the role of the HUD computer to include many weapon aiming functions which have considerably improved weapon delivery effectiveness particularly in the air to air modes. The fire control system of the YF16 prototype air combat fighter is one of the most recent systems of this type and has proved highly effective in the Edwards AFB fly-off. The latest example of this type of system is the Marconi-Elliott 664 which further extends the capabilities by the use of a fast 8K, 16 bit computer. This equipment uses MSI and LSI technology and offers a significantly increased range of weapon delivery modes at a comparable cost to earlier simple HUD systems. Author

N76-17133 Ferranti, Ltd., Edinburgh (Scotland). Inertial Systems Dept.

THE APPLICATION OF ELECTRONIC AND COMBINED DISPLAYS TO GROUND MAPPING AND NAVIGATION

W. H. McKinlay *In* AGARD Electron. Airborne Displays Dec. 1975 5 p (For availability see N76-17107 08-06)

The evolution is reviewed of navigation displays and the growth of their pictorial content. Civil and military requirements are treated. Examples of a pictorial display for transport aircraft, and a Combined Display including topographical data for military aircraft are presented. Problems of data storage and the increasing need for color are mentioned. The combined display for military aircraft is introduced and it is pointed out in particular that it permits an evolutionary approach by pilots because it retains topographical data, yet presents many new possibilities because of its versatile electronic element. Some possible future developments are mentioned and the conclusion is drawn that certain real operational constraints may be as significant as the availability of more flexible technologies. Author

N76-17134 Ferranti, Ltd., Edinburgh (Scotland). Inertial Systems Dept.

COMED: A COMBINED DISPLAY INCLUDING A FUEL ELECTRONIC FACILITY AND A TOPOGRAPHICAL MOVING MAP DISPLAY

William M. Aspin *In* AGARD Electron. Airborne Displays Dec. 1975 11 p refs (For availability see N76-17107 08-06)

The design and construction of a new combined map and electronic display (COMED) developed for use in fighter/attack aircraft are described. The operational advantages of this type of display are discussed in the context of earlier and alternative types of combined display. The principle design aims of the COMED display are described, and how these aims have been met, is explained. Author

N76-17135 Technische Univ., Berlin (West Germany). Inst. fuer Luft und Raumfahrt.

ELANDIS: A VERTICAL SITUATION DISPLAY

Wolfgang Holstein *In* AGARD Electron. Airborne Displays Dec. 1975 6 p refs (For availability see N76-17107 08-06)

An interim report of a study of display requirements for final approach management of STOL-aircraft is presented. The proposal of this electronic landing display (ELANDIS) is based on the perspective view of the vertical situation of STOL-aircraft in landing. The concept allows a continuous surveillance of the automatic landing system and provides sufficient information which enables the pilot to carry out the landing manually (if desired or necessary in case of failure). Furthermore there is a brief description of the hardware configuration of the hybrid simulation system (HSS). In its present state the HSS consists of an analog computer EA1 580, a digital computer PDP-11/20, a graphic display terminal GT 40, a simulation cockpit and a magnetic tape station MBB/Ampex. The software concept gives a general view of the dataflow. Author

N76-17136 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

ASTROLABE, AN INTEGRATED NAVIGATION AND LANDING AID SYSTEM: ON BOARD AND GROUND DISPLAY OF INFORMATIONS

Jacques Dorey and Guy Ringenbach *In* AGARD Electron. Airborne Displays Dec. 1975 8 p refs In FRENCH; ENGLISH summary (For availability see N76-17107 08-06)

ONERA is developing a microwave localization system, based on the properties of synthetic antennas, which permits the two-dimensional (azimuth and elevation), simultaneous analysis of large number of targets made of low power beacons. This system ensures airspace surveillance, and at the same time provides the pilot with a visualization of the surrounding terrain (e.g. runway boundaries) with the proper perspective. It permits the integration of various functions of ground control necessary to the pilot in blind navigation. The data processing and display devices are described associated with this system: an optic device, and an integrated digital device. The results are analyzed, and the application possibilities of the system are presented. Author

N76-17137 Marconi-Elliott Avionic Systems Ltd., Rochester (England).

A MULTI-SENSOR MULTI-FUNCTION DISPLAY FOR THE PANAVIA MULTI-ROLE COMBAT AIRCRAFT

D. W. Hussey *In* AGARD Electron. Airborne Displays Dec. 1975 12 p (For availability see N76-17107 08-06)

The weapon system operator's principal access to the wide range of raw sensor and processed data available on the MRCA was implemented by the development of an integrated electronic display system. The equipment is one of the first to solely utilize a standard television raster to display both synthetic tabular and graphical data in a form directly compatible with EO Sensor television video signals. An electronically labelled multifunction keyboard allows the crew member to access and update the computing system data in a wide variety of modes using the minimum of controls and panel space. The generation of synthetic symbols directly in the raster by modulation of the video signal is achieved by a novel form of time-shared digital techniques providing high accuracy and resolution with a considerable economy of hardware. A particular feature of the system is the elimination of staircasing of the raster generated graphics. Other aspects include the achievement of high resolution and contrast under conditions of extreme cockpit ambient illumination. The system forms the basis of a new range of head down displays which are being developed for a wide range of military aircraft types. Author

N76-17138 Thomson-CSF, Issy les Moulineaux (France). Groupe Optronique.

CHARACTERISTICS OF HEAD-UP DISPLAY SYSTEMS [CARACTERISTIQUES DU COLLIMATEUR DE TIR ET DE PILOTAGE (HUD)]

M. Martin *In* AGARD Electron. Airborne Displays Dec. 1975 4 p In FRENCH (For availability see N76-17107 08-06)

Development of second-generation head-up display systems coupled to large capacity computers that may provide not only a complex visual presentation but may also undertake all computations required for air-to-air and air-to-ground firing was reviewed. Further Applications of head-up display systems to civil aviation, primarily in relation to blind flying near ground level (automated landing approach) were also discussed. It was shown that the problem of integrating the computation and symbol generation functons for both military and civil applications may be treated similarly, although military applications tend to be more complex. A general purpose computer with a capacity of 5000 16 bit words would be adequate for these applications. Physical specifications of the image and field of view were given. Transl. by Y.J.A.

N76-17139 Royal Aircraft Establishment, Farnborough (England).

A PROGRAMMABLE RASTER-BASED DISPLAY SYSTEM FOR USE WITH ELECTRO-OPTICAL SENSORS

R. G. White (Marconi Elliott Avionic Sys. Ltd.) *In* AGARD Electron. Airborne Displays Dec. 1975 9 p refs (For availability see N76-17107 08-06)

An experimental airborne, programmable raster-based electronic display system is presented, capable of generating a variety of symbology and superimposing this on a picture of the outside world provided by a forward looking daylight or low light television camera. Examples of the symbology which can be generated by the display system are described in particular the initial symbology chosen for flight trails to investigate the potential of night vision sensors for low level, high speed flight at night. The philosophy of superimposing flight information on the picture from a night vision sensor is discussed, and it is concluded that superimposed symbology is necessary if an aircraft's night time capability is to be effectively extended. Author

N76-17140 Siemens A.G., Munich (West Germany).

WILL THE FUTURE ELECTRONIC AIRBORNE DISPLAY BE STEREOSCOPIC?

R. Stark *In* AGARD Electron. Airborne Displays Dec. 1975 17 p refs (For availability see N76-17107 08-06)

Research into a method of air traffic control aimed at the realization of a cockpit display which permits the pilot to participate actively in air traffic control is reported. The goal was the three-dimensional representation of airways and aircraft ahead, as seen by the pilot. The working conditions of the pilots were examined with the aid of a simulator and scenes featuring relevant traffic situations were shot for a 3D-film. The pilot depends on a microcomputer and a color display unit for the method proposed. Data supplied by ground stations and airborne sensors are stored and processed on-line, i.e. in step with the picture data. For this purpose the object coordinates are transformed to the aircraft position and projected onto the picture screen separately for the left and right eyes. The mathematics, simulation equipment and simulation programs are described. The time requirements and the volume of data transmitted and processed are assessed. The results favor a stereoscopic display. Author

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N76-17141*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POTENTIAL USE OF CERAMIC COATING AS A THERMAL INSULATION ON COOLED TURBINE HARDWARE
Curt H. Liebert and Francis S. Stepka Washington Feb. 1976 24 p refs
(NASA-TM-X-3352; E-8557) Avail: NTIS HC $3.50 CSCL 21E

An analysis was made to determine the potential benefits of using a ceramic thermal insulation coating of calcia-stabilized zirconia on cooled engine parts. The analysis was applied to turbine vanes of a high temperature and high pressure core engine and a moderate temperature and low pressure research engine. Measurements made during engine operation showed that the coating substantially reduced vane metal wall temperatures. Evaluation of the durability of the coating on turbine vanes and blades in a furnace and engine were encouraging. Author

N76-17142*# Transemantics, Inc., Washington, D.C.
EFFECT OF THE REYNOLDS NUMBER ON THE PARAMETERS OF A TURBOJET ENGINE
Walerian Kordzinski Washington NASA Feb. 1976 19 p refs Transl. into ENGLISH from Technika Lotnicza Astronautyczna (Poland), v. 22, Nov. 1967 p 3-7
(Contract NASw-2792)
(NASA-TT-F-16854) Avail: NTIS HC $3.50 CSCL 21E

Using experimentally determined values for the coefficients of the influence of the Reynolds number on the temperature behind the turbine and on the air consumption (obtained from the literature), analogous coefficients are calculated for the isentropic and actual work of compression, the compression itself, the compressor efficiency, the turbine efficiency, and the coefficient of the air surplus. The obtained results make it possible to improve the accuracy of turbojet engine parameter and performance calculations for high altitude flight conditions. The calculations are chiefly intended for an engine with a constant-cross-section outlet nozzle having regulation at a constant actual angular velocity, but may be applied to separate driving turbine. Author

N76-17143*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADVANCED TURBINE DISK DESIGNS TO INCREASE RELIABILITY OF AIRCRAFT ENGINES
Albert Kaufman 1976 32 p refs Proposed for presentation at Gas Turbine Conf., New Orleans, 21-25 Mar. 1976; sponsored by ASME
(NASA-TM-X-71804; E-8491) Avail: NTIS HC $4.00 CSCL 21E

Results of analytical studies to improve the low cycle fatigue lives and reliability of turbine disks in high performance gas turbine engines are presented. Advanced disk concepts were evaluated for the first stage high pressure turbines of the CF6-50 and JT8D-17 engines. The advanced disk designs are compared to the existing disks on the bases of cycles to crack initiation and overspeed capability for initially unflawed disks, crack propagation cycles to failure for initially flawed disks, and available kinetic energy of disk burst fragments. Author

N76-17144*# General Electric Co., Cincinnati, Ohio.
ADDITIONAL DESIGN STUDIES OF THE NASA/NAVY LIFT/CRUISE FAN
5 Jan. 1976 34 p refs
(Contract NAS3-19411)
(NASA-CR-134928; R76AEG152) Avail: NTIS HC $4.00 CSCL 21E

Additional preliminary design studies were performed for a turbotip lift/cruise fan propulsion system for a Navy multimission aircraft. The LCF459/J97 propulsion system was previously designed for this application. These studies extended the analysis in areas of (1) scroll commonality, (2) increased engine-out contingency ratings, (3) mounting systems, (4) manufacturing cost reductions, and (5) vulnerability. Author

N76-17145*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW SPEED WIND TUNNEL INVESTIGATION OF THE AERODYNAMIC AND ACOUSTIC PERFORMANCE OF SEVERAL SONIC INLET TAKEOFF AND APPROACH GEOMETRIES
John M. Abbott and Richard L. Golladay Washington Feb. 1976 50 p refs
(NASA-TM-X-3332; E-8445) Avail: NTIS HC $4.00 CSCL 01A

A series of tests was conducted to determine the aerodynamic and acoustic performance of several sonic inlet takeoff and approach geometries. The effects of inlet lip shape and diffuser length were also investigated. The tests were conducted in a low-speed wind tunnel at free-stream velocities of 0 and 45 meters per second. Inlet incidence angle was varied from 0 deg to 50 deg. The inlets were sized to fit a 13.97-centimeter-diameter fan. In terms of the highest level of inlet total pressure recovery for a given amount of noise suppression, a cylindrical centerbody takeoff geometry and a bulb-shaped centerbody approach geometry provided the best results over all conditions of free-stream velocity and incidence angle. Increasing inlet lip contraction ratio extended the maximum incidence angle for attached lip flow, while increasing inlet diffuser length resulted in a higher total pressure recovery for a given amount of noise suppression. Author

N76-17146*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAM FOR DESIGN ANALYSIS OF RADIAL-INFLOW TURBINES
Arthur J. Glassman Washington Feb. 1976 66 p refs
(NASA-TN-D-8164; E-8394) Avail: NTIS HC $4.50 CSCL 21E

A computer program written in FORTRAN that may be used for the design analysis of radial-inflow turbines was documented. The following information is included: loss model (estimation of losses), the analysis equations, a description of the input and output data, the FORTRAN program listing and list of variables, and sample cases. The input design requirements include the power, mass flow rate, inlet temperature and pressure, and rotational speed. The program output data includes various diameters, efficiencies, temperatures, pressures, velocities, and flow angles for the appropriate calculation stations. The design variables include the stator-exit angle, rotor radius ratios, and rotor-exit tangential velocity distribution. The losses are determined by an internal loss model. Author

N76-17147*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SLOTTED CASING TREATMENT ON PERFORMANCE OF A MULTISTAGE COMPRESSOR
John E. Moss, Jr. Washington Feb. 1976 20 p refs
(NASA-TM-X-3350; E-8485) Avail: NTIS HC $3.50 CSCL 21E

A J85-13 engine was equipped with a compressor case that allowed changes to the case wall over the rotor tips of six of its eight stages. The engine was tested with four inlet configurations: uniform inlet flow, 180 degree circumferential distortion, hub radial distortion, and tip radial distortion. Slotted inserts were installed in the first three stages, and the compressor was mapped under similar conditions. Overall compressor performance obtained with tip treatment was inferior to the performance for the compressor's normal operating range. Pumping capacity with the slotted inserts was reduced. Overall compressor efficiency was reduced 1 to 2 percent with the slotted rings installed for 90 and 100 percent corrected engine speeds. Author

N76-17148*# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
A TWO-DIMENSIONAL FINITE-DIFFERENCE SOLUTION FOR THE TEMPERATURE DISTRIBUTION IN A RADIAL GAS TURBINE GUIDE VANE BLADE
W. M. Hosny and W. Tabakoff Sep. 1975 57 p refs
(Contract NAS2-7850)
(NASA-CR-137633) Avail: NTIS HC $4.50 CSCL 21E

A two-dimensional finite difference numerical technique is presented to determine the temperature distribution in a solid blade of a radial guide vane. A computer program is written in Fortran IV for IBM 370/165 computer. The computer results

obtained from these programs have a similar behavior and trend as those obtained by experimental results. Author

N76-17149*# General Applied Science Labs., Inc., Westbury, N.Y.
EFFECT OF PREMIXING QUALITY ON OXIDES OF NITROGEN IN GAS TURBINE COMBUSTORS FOI HC Final Report
Gerald Roffe and Antonio Ferri Feb. 1976 52 p refs
(Contract NAS3-18563)
(NASA-CR-2657; TR-793) Avail: NTIS HC $4.50 CSCL 21E

Experiments were conducted to determine the effectiveness of several premixing prevaporizing gas turbine combustor designs in reducing formation of oxides of nitrogen at the supersonic cruise condition. An atomized spray from a single injector mounted on the axis of the mixer tube produced a high initial concentration of fuel near the axis and only moderate premixed conditions entering the combustor. A fuel spray produced by 12 flush-mounted normal injection orifices in the mixer tube wall produced a good initial despersion of fuel and resulted in nearly complete premixing. Oxides of nitrogen emission levels of the order of 0.2 g NO2/kg fuel were obtained at 99 percent combustion efficiency at an equivalence ratio of 0.4. Overall total pressure drop was less than 3 percent through the 1-meter combustor module. Author

N76-17150# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.
STUDIES ON TRANSONIC TURBINES WITH FILM COOLED BLADES Annual Technical Report, 1 Jul. 1974 - 30 Jun. 1975
O. M. Amana, H. O. Demuren, and J. F. Louis Jun. 1975 138 p refs
(Contract N00014-67-A-0204-0079; NR Proj. 094-370)
(AD-A015321; TR-75-1; ATR-2) Avail: NTIS CSCL 21/5

In the second year of the contract, significant advances were made building on the preliminary studies carried out in the first year. A two-dimensional analytical model has been formulated for the aerodynamic flow around the trailing edge of transonic blades based on data collected last year and the capability of the model to predict the base pressure. The trailing edge shock system and the local wake angle have been tested against cascade data. A comparison between predicted and measured parameters show that the model is superior to other methods. The method also addresses the modeling of round trailing edges. GRA

N76-17341 European Space Agency, Paris (France).
SYSTEMATIC INVESTIGATIONS INTO THE EFFECTS OF EXIT VELOCITY, JET TEMPERATURE AND GROUND CLEARANCE ON THE MIXING PROCESSES IN LIFTING JETS
Manfred Strauber and T. H. Darmstadt *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 178-191 refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/ Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 p 178-191 (For availability see N76-17332 08-34)

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N76-17151*# Boeing Commercial Airplane Co., Seattle, Wash.
A METHOD FOR PREDICTING THE STABILITY CHARACTERISTICS OF AN ELASTIC AIRPLANE. VOLUME 1: FLEXSTAB THEORETICAL DESCRIPTION An Early Domestic Dissemination Report
A. R. Dusto, G. W. Brune, G. M. Dornfeld, J. E. Mercer, S. C. Pilet, P. E. Rubbert, R. C. Schwanz, P. Smutny, E. N. Tinoco, and J. A. Weber Oct. 1974 652 p refs
(Proj. FEDD; Contract NAS2-5006)
(NASA-CR-114712; D6-41064-1-Vol-1) Avail: NASA Industrial Applications Centers only to U.S. Requesters: HC $16.25/MF $2.25 CSCL 01C

A theoretical development of the FLEXSTAB system is presented. The development integrates the theoretical mechanics of a flexible body with a low frequency unsteady aerodynamic theory employing linear influence coefficients based on finite element approximations. The theoretical mechanics resolve the dynamics of a flexible aircraft into structural dynamics of free vibration modes superimposed on rigid body dynamics. This resolution is made using a mean reference frame for structural motions and leads to two important features of the FLEXSTAB system: one, a logical merger of quasi-steady and dynamic aeroelasticity through the residual flexibility approximation; and, two, a logical basis for incorporating into the analysis empirical, rigid aircraft aerodynamic data. The aerodynamic theory is applicable to subsonic and supersonic flow and multiple wing-body-tail-nacelle configurations. Aerodynamic influence coefficients are derived using a paneling scheme which lends itself to empirical corrections. Finally, the theoretical aero-and structural dynamics are integrated, conserving energy of the system and thereby yielding equations of motion appropriate to stability evaluation. These equations are expressed for a steady, reference motion to determine trim and static stability. They are also expressed in terms of unsteady perturbations about the reference motion to determine dynamic stability by characteristic roots or by time histories following an initial perturbation or following penetration of a discrete gust flow field. Author

N76-17152*# Boeing Commercial Airplane Co., Seattle, Wash.
A METHOD FOR PREDICTING THE STABILITY CHARACTERISTICS OF AN ELASTIC AIRPLANE. VOLUME 2: FLEXSTAB 1.02.00 USER'S MANUAL An Early Domestic Dissemination Report
G. R. Hink, R. N. Snow, K. G. Bhatia, R. E. Maier, G. R. Bills, D. M. Henderson, D. C. Bailey, G. M. Dornfeld, and P. V. DAuria Oct. 1974 564 p refs
(Proj. FEDD; Contract NAS2-5006)
(NASA-CR-114713; D6-41064-2-Vol-2) Avail: NASA Industrial Applications Centers only to U.S. Requesters: HC $13.50/MF $2.25 CSCL 01C

A system of computer programs (FLEXSTAB) designed to predict the stability and control characteristics of an elastic airplane in the subsonic and supersonic flight regimes from geometry, mass distribution, and flexibility information is described. The FLEXSTAB 1.02.00 User's Manual includes sufficient detail to enable the user to prepare input data decks, execute programs, and interpret results. It is assumed that the user is knowledgeable in the dynamics of aircraft and has been introduced to computer programming applications. Author

N76-17153*# Boeing Commercial Airplane Co., Seattle, Wash.
A METHOD FOR PREDICTING THE STABILITY CHARACTERISTICS OF AN ELASTIC AIRPLANE. VOLUME 3: FLEXSTAB 1.02.00 PROGRAM DESCRIPTION An Early Domestic Dissemination Report
G. R. Hink, P. V. DAuria, D. C. Bailey, G. R. Bills, and D. M. Henderson Oct. 1974 753 p refs
(Proj. FEDD; Contract NAS2-5006)
(NASA-CR-114714; D6-41064-3-Vol-3) Avail: NASA Industrial Applications Centers only to U.S. Requesters: HC $18.75/MF $2.25 CSCL 01C

A computer program system (FLEXSTAB) developed from integrated aerodynamic, structural, and flight control methods is described. Static and dynamic stability, trim state, structural loading, and elastic deformation of aircraft configurations at subsonic and supersonic speeds are evaluated. The architecture of the FLEXSTAB system is illustrated along with important internal blocks of logic within each program of the system. General information flow schematics depicting major areas where data are input to and output from each program are also shown. A guide to program maintenance, updating, and modification is provided. Author

N76-17154*# Honeywell, Inc., Minneapolis, Minn.
PRELIMINARY SYSTEM DESIGN STUDY FOR A DIGITAL FLY-BY-WIRE FLIGHT CONTROL SYSTEM FOR AN F-8C AIRCRAFT Final Report
C. L. Seacord and D. K. Vaughn Washington NASA Jan.

1976 219 p refs
(Contract NAS1-12956)
(NASA-CR-2609) Avail: NTIS HC $7.75 CSCL 01C

The design of a fly-by-wire control system having a mission failure probability of less than one millionth failures per flight hour is examined. Emphasis was placed on developing actuator configurations that would improve the system performance, and consideration of the practical aspects of sensor/computer and computer/actuator interface implementation. Five basic configurations were defined as appropriate candidates for the F-8C research aircraft. Options on the basic configurations were included to cover variations in flight sensors, redundancy levels, data transmission techniques, processor input/output methods, and servo actuator arrangements. The study results can be applied to fly by wire systems for transport aircraft in general and the space shuttle. Author

N76-17155*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
F-8C DIGITAL CCV FLIGHT CONTROL LAWS Final Report, Oct. 1973 - Sep. 1974
Gary L. Hartmann, James A. Hauge, and Russell C. Hendrick Feb. 1976 459 p refs
(Contract NAS1-12680)
(NASA-CR-2629) Avail: NTIS HC $12.00 CSCL 01C

A set of digital flight control laws were designed for the NASA F-8C digital fly-by-wire aircraft. The control laws emphasize Control Configured Vehicle (CCV) benefits. Specific pitch axis objectives were improved handling qualities, angle-of-attack limiting, gust alleviation, drag reduction in steady and maneuvering flight, and a capability to fly with reduced static stability. The lateral-directional design objectives were improved Dutch roll damping and turn coordination over a wide range in angle-of-attack. An overall program objective was to explore the use of modern control design methodology to achieve these specific CCV benefits. Tests for verifying system integrity, an experimental design for handling qualities evaluation, and recommended flight test investigations were specified. Author

N76-17156*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
SUMMARY OF FLIGHT TESTS TO DETERMINE THE SPIN AND CONTROLLABILITY CHARACTERISTICS OF A REMOTELY PILOTED, LARGE-SCALE (3/8) FIGHTER AIRPLANE MODEL
Euclid C. Holleman Washington Jan. 1976 126 p refs
(NASA-TN-D-8052; H-889) Avail: NTIS HC $6.00 CSCL 01C

An unpowered, large, dynamically scaled airplane model was test flown by remote pilot to investigate the stability and controllability of the configuration at high angles of attack. The configuration proved to be departure/spin resistant; however, spins were obtained by using techniques developed on a flight support simulator. Spin modes at high and medium high angles of attack were identified, and recovery techniques were investigated. A flight support simulation of the airplane model mechanized with low speed wind tunnel data over an angle of attack range of + or - 90 deg. and an angle of sideslip range of + or - 40 deg. provided insight into the effects of altitude, stability, aerodynamic damping, and the operation of the augmented flight control system on spins. Aerodynamic derivatives determined from flight maneuvers were used to correlate model controllability with two proposed departure/spin design criteria. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N76-17157*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A DISCUSSION OF DYNAMIC STABILITY MEASUREMENT TECHNIQUES
Wayne Johnson Nov. 1975 38 p refs Prepared in cooperation with Army Air Mobility Res. and Develop. Lab., Moffett Field, Calif.
(NASA-TM-X-73081; A-6371) Avail: NTIS HC $4.00 CSCL 14B

Techniques for the measurement of the dynamic stability of linear systems are discussed. Particular attention is given to an analysis of the errors in the procedures, and to methods for calculating the system damping from the data. The techniques discussed include: transient decay, moving block analysis, spectral analysis, random decrement signatures, transfer function analysis, and parameter identification methods. The special problems of rotorcraft dynamic stability testing are discussed. Author

N76-17158*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SKYLAB MATERIALS PROCESSING FACILITY EXPERIMENT DEVELOPER'S REPORT
P. G. Parks 1 Jul. 1975 176 p Prepared in cooperation with Martin Marietta Corp., Denver
(Contract NAS8-24000)
(NASA-TM-X-64977; ED-2002-1770) Avail: NTIS HC $7.50 CSCL 14B

The development of the Skylab M512 Materials Processing Facility is traced from the design of a portable, self-contained electron beam welding system for terrestrial applications to the highly complex experiment system ultimately developed for three Skylab missions. The M512 experiment facility was designed to support six in-space experiments intended to explore the advantages of manufacturing materials in the near-zero-gravity environment of Earth orbit. Detailed descriptions of the M512 facility and related experiment hardware are provided, with discussions of hardware verification and man-machine interfaces included. An analysis of the operation of the facility and experiments during the three Skylab missions is presented, including discussions of the hardware performance, anomalies, and data returned to earth. Author

N76-17159# Naval Air Engineering Center, Lakehurst, N.J. Ground Support Equipment Dept.
MEASUREMENT OF NC-8A AND MMG-1A DISTORTION SPECTRUMS Final Report, Jul. 1974 - Jun. 1975
J. Hryhorec Jun. 1975 46 p refs
(WF41461406)
(AD-A014921; NAEC-GSED-89) Avail: NTIS CSCL 10/2

AC and dc distortion spectrum measurements were made on an NC-8A and an MMG-1A Mobile Electric Power Plant. The results were plotted and compared with the distortion spectrum limits of MIL-STD-704B. Conclusions are reached and recommendations are made based on the results obtained. The NC-8A is a mobile, driver operable, self-propelled, self-contained, electric power plant utilized for servicing and/or starting rotary and fixed wing aircraft. The primary source of power is a Diesel Engine with a rating of 118 brake horsepower at 2400 RPM. The MEPP is designed to produce 60 KVA at 400 Hz, 120/128 volt ac power and 500 amperes at 28 volts dc continuous or 750 amperes (Current limited) intermittent power. Both ac and dc power may be supplied simultaneously for loads up to 48 KW. GRA

N76-17160# Naval Air Engineering Center, Lakehurst, N.J. Ground Support Equipment Dept.
FEASIBILITY STUDY OF MAXIMUM FLOW FUEL SYSTEM FOR AIRCRAFT REFUELING Final Report
W. Womer Jun. 1975 39 p refs
(AD-A015186; NAEC-GSED-92) Avail: NTIS CSCL 21/4

The report describes a proposed scheme to boost the carrier refueling rate for aircraft from the conventional 175 gpm to 600 gpm or more, or the acceptance rate of the aircraft. The scheme would apply to CVA-66 as baseline carrier. GRA

N76-17161# Naval Air Engineering Center, Lakehurst, N.J. Ground Support Equipment Dept.
FIXED POINT AIRCRAFT UTILITY SUPPORT SYSTEM ECONOMIC FEASIBILITY ANALYSIS
W. Murphy, D. Smith, and J. J. Geddes 25 Jun. 1975 137 p (AD-A015175; NAEC-GSED-86) Avail: NTIS CSCL 01/5

The primary objective of the study is to determine the economic feasibility of providing Naval/Marine Corps air stations with centralized systems which would provide utility service which is presently supplied by mobil ground support equipment GSE. The services included in this study will be limited to stating GSE air, Cooling Air, Shop Air, 400 Hz and 60 Hz Electrical Power. These services would be distributed to appropriate locations in hangars and to service islands on the parking apron, via underground and bulkhead distribution systems. Such systems are intended to reduce the quantity of mobile GSE required in the Navy inventory, and its attendant high cost at those bases where operations warrant them. GRA

N76-17162# New Mexico Univ., Albuquerque. Eric H. Wang Civil Engineering Research Facility.
INSTRUCTION MANUAL FOR MOBILE NONDESTRUCTIVE VIBRATORY TEST EQUIPMENT Final Report, 15 Nov. 1973 - 30 Nov. 1974
Glenn T. Baird, John Ritts, and Ron Anderbery Aug. 1975 77 p refs
(Contract F29601-74-C-0030; AF Proj. 2104)
(AD-A014911; AFWL-TR-74-301) Avail: NTIS CSCL 14/2

Detailed operating instructions for use of the nondestructive pavement testing van developed at the Civil Engineering Research Facility, University of New Mexico, are outlined. Full descriptions of the equipment components are included as well as appropriate operator checklists. GRA

N76-17163# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
TRANSONIC WIND-TUNNEL FACILITY AT THE NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER Final Report
Jun. 1975 56 p ref
(AD-A014927; ASED-332) Avail: NTIS CSCL 14/2

The 7- by 10-Foot transonic wind tunnel at the Naval Ship Research and Development Center is described together with some of the associated test support equipment, and testing capabilities. Procedures for potential users to follow in arranging for test and analysis services are included. GRA

N76-17164# ARO, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL EVALUATION OF THE AERODYNAMIC DESIGN CRITERIA AND PERFORMANCE OF A TRANSONIC LUDWIEG TUBE WIND TUNNEL Final Report, Jul. 1974 - Mar. 1975
M. O. Varner, D. W. Stallings, and R. F. Starr AEDC Oct. 1975 15 p refs
(AD-A016723; ARO-VKF-TR-75-82; AEDC-TR-75-132) Avail: NTIS CSCL 14/2

This report presents the results of continued studies into the details of the aerodynamic processes which govern the operation of a Ludwieg tube transonic tunnel. Refinements in the configuration of the flow-conditioning channel (nozzle, test section and diffuser), which represent an improvement over a previous design are described. Detailed analyses of the starting process, ejector flap performance, and wall loadings during the starting process are covered. Emphasis has been placed on understanding and describing the fundamental mechanisms which govern the aerodynamic behavior such that meaningful performance estimates can be made for facilities of different size or slightly different configurations. GRA

N76-17165# National Center for Atmospheric Research, Boulder, Colo. Atmospheric Quality and Modification Div.
THE NCAR VERTICAL WIND TUNNEL: A VERTICAL WIND TUNNEL FOR CONTROLLING THE MOTION AND ENVIRONMENT OF ATMOSPHERIC PARTICLES
Louis D. Breyfogle, Theodore W. Cannon, and J. Doyne Sartor Nov. 1974 48 p refs Sponsored by NSF
(PB-245769/5; NCAR-TN/EDD-102) Avail: NTIS HC $4.00 CSCL 14B

The NCAR wind tunnel which provides a vertically directed air flow that may be varied to control the vertical motion of particles, or to suspend particles for study is described. The environmental conditions are varied over a range of temperature (-25 to +27 C), humidity (-45 C frost point to saturation at +27 C), electric field, and vertical velocity (1.25 cm/sec to 9 5 m/sec). The drop size that can be supported by the vertical flow varies from diameters of about 20 micrometers to about 5 mm. This wide range of variation permits duplication of environmental conditions so that water drops and ice particles and their interactions may be studied in the laboratory under environmental conditions similar to those found in nature. GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N76-17166*# National Aeronautics and Space Administration, Washington, D.C.
ASTRONAUTICS AND AERONAUTICS, 1973: CHRONOLOGY OF SCIENCE, TECHNOLOGY AND POLICY
1975 487 p refs
(NASA-SP-4018; LC-65-60308) Avail: NTIS MF $2.25; SOD HC $4.90 CSCL 22A

A brief chronological account is presented of key events of the year in aerospace sciences. Dates, actions, hardware, persons, scientific discoveries are recorded along with plans, decisions, achievements and preliminary evaluations of results. Samples of public reaction and social impact are included. Sources are identified and an index is provided to aid in tracing related events through the year. The index also serves as a glossary of acronyms and abbreviations. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N76-17167*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A STUDY OF MARINER 10 FLIGHT EXPERIENCES AND SOME FLIGHT PIECE PART FAILURE RATE COMPUTATIONS
Floyd A. Paul 15 Jan. 1976 31 p refs
(Contract NAS7-100)
(NASA-CR-145933; JPL-TM-33-759) Avail: NTIS HC $4.00 CSCL 22B

The problems and failures encountered in Mariner flight are discussed and the data available through a quantitative accounting of all electronic piece parts on the spacecraft are summarized. It also shows computed failure rates for electronic piece parts. It is intended that these computed data be used in the continued updating of the failure rate base used for trade-off studies and predictions for future JPL space missions. Author

N76-17168*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER VENUS-MERCURY 1973 PROJECT. VOLUME 2: EXTENDED MISSION-MERCURY 2 AND 3 ENCOUNTERS Final Report
1 Dec. 1975 117 p refs
(Contract NAS7-100)
(NASA-CR-145935; JPL-TM-33-734-Vol-2) Avail: NTIS HC $5.50 CSCL 22C

The Mariner Venus/Mercury 1973 mission operations Extended Mission is described. The activities are summarized from shortly after Mercury I through the end of mission. The operational activities are reported by Mission Operations Systems functions providing a brief summary from each discipline. Based on these experiences recommendations for future projects are made. Author

N76-17169*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
SOLAR ELECTRIC GEOCENTRIC TRANSFER WITH AT-

TITUDE CONSTRAINTS: ANALYSIS Final Technical Report
Lester L. Sackett, Harvey L. Malchow, and Theodore N. Delbaum Aug. 1975 140 p refs
(Contract NAS3-18886)
(NASA-CR-134927; CSDL-R-901) Avail: NTIS HC $6.00 CSCL 22A

A time optimal or nearly time optimal trajectory program was developed for solar electric geocentric transfer with or without attitude constraints and with an optional initial high thrust stage. The method of averaging reduces computation time. A nonsingular set of orbital elements is used. The constraints, which are those of one of the SERT-C designs, introduce complexities into the analysis and the solution yields possible discontinuous changes in thrust direction. The power degradation due to VanAllen radiation is modeled analytically. A wide range of solar cell characteristics is assumed. Effects such as oblateness and shadowing are included. The analysis and the results of many example runs are included. Author

N76-17170*# Joint Publications Research Service, Arlington, Va.
COSMONAUTICS, THE SCIENTIFIC-TECHNICAL REVOLUTION, AND WORLD OUTLOOK
V. A. Sevastyanov and A. D. Ursul Washington NASA Feb. 1976 16 p refs Transl. into ENGLISH from Vopr. Filosofii (USSR), no. 11, 1976 p 81-92
(NASA Order W-13183)
(NASA-TT-F-16873) Avail: NTIS HC $3.50 CSCL 22A

The development of theoretical and practical cosmonautics in the Soviet Union is discussed along with the necessary economic, socio-cultural, and scientific and technical conditions. Author

N76-17171*# Analytical Mechanics Associates, Inc., Seabrook, Md.
RESEARCH IN ORBIT DETERMINATION OPTIMIZATION FOR SPACE TRAJECTORIES Final Report, Feb. 1972 - Sep. 1975
S. Pines and H. Kelley Sep. 1975 59 p refs
(Contract NAS9-12516)
(NASA-CR-147435; AMA-76-2) Avail: NTIS HC $4.50 CSCL 22A

Research data covering orbit determination, optimization techniques, and trajectory design for manned space flights are summarized. Author

N76-17172*# LTV Aerospace Corp., Dallas, Tex. Vought Systems Div.
SATELLITE LIFETIME ROUTINE USER'S MANUAL
H. U. Everett and T. R. Myler [1975] 43 p refs
(Contract NAS1-12500)
(NASA-CR-144941) Avail: NTIS HC $4.00 CSCL 22A

A FORTRAN coded computer program which determines secular variations in mean orbital elements of earth satellites and the lifetime of the orbit is described. The dynamical model treats a point mass satellite subject to solar and lunar disturbing gravitational fields, second, third and fourth harmonics of the earth's oblate potential, earth's atmospheric drag, and solar radiation pressure. Each of these disturbing functions may be selectively simulated. Data preparation instructions, a sample problem, and definitions of output quantities are included.Author

N76-17173*# Science Applications, Inc., Rolling Meadows, Ill.
JUPITER ORBITER LIFETIME: THE HAZARD OF GALILEAN SATELLITE COLLISION
Alan L. Friedlander 14 Feb. 1975 79 p refs
(Contract NASw-2613)
(NASA-CR-146396; SAI-1-120-194-T2) Avail: NTIS HC $5.00 CSCL 22C

The four Galilean satellites of Jupiter present a long-term collision hazard to an uncontrolled orbiting spacecraft that repeatedly enters the spatial region occupied by the satellites. Satellite close encounters and the likelihood of collision over a wide range of initial orbit conditions were analyzed. The effect of orbit inclination was of key interest. The scope of the analysis was restricted to orbital dynamic considerations alone, i.e. the question of biological contamination given the event of collision was not considered. A quarantine or orbiter lifetime of 50 years was assumed. This time period begins at spacecraft shutdown following completion of the mission objectives. A numerical approach was adopted wherein each initial orbit is propagated for 50 years, and satellite closest encounter distances recorded on every revolution. The computer program includes approximations of the three major perturbation effects on the long-term motion of the orbiter: (1) Jupiter oblateness, (2) solar gravity, and (3) satellite gravity. Author

N76-17174# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE CHANGE IN ARTIFICIAL SATELLITE ACCELERATION DURING PERIODS OF ELEVATED GEOMAGNETIC ACTIVITY
V. N. Chepurnoi and G. A. Charina [1975] 4 p refs Transl. into ENGLISH from Geomagn. i Aeron. (USSR), v. 15, no. 5, 1975 p 927-929
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Perturbations in the acceleration of artificial satellites during strong magnetic storms were analyzed. It was established that the acceleration perturbations lag the planetary index of geomagnetic activity by approximately five hours. The factors for assuming that the drag increases due to the presence of high concentrations of excited atoms and molecules transferring a large impulse to the surface are discussed. It is concluded that the changes in acceleration can be explained by an increase in the upper atmosphere temperature, and a rise in the excited particle concentrations. F.O.S.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N76-17175*# Linguistic Systems, Inc., Cambridge, Mass.
CNES GROUND SYSTEM CONFIGURATIONS FOR SYMPHONIE
G. Cales Washington NASA Feb. 1976 21 p Transl. into ENGLISH of "Configurations du systeme sol CNES pour SYMPHONIE", Rept. 385/CB/OPS/SP Centre Spatial de Bretigny, France, 26 Feb. 1974 p 1-20
(Contract NASw-2482)
(NASA-TT-F-16720) Avail: NTIS HC $3.50 CSCL 22D

A brief description is given of the CNES ground system. Attention is then directed at the functional organization for SYMPHONIE operations, and finally at the ground system phases and configurations. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N76-17176*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC DYNAMIC-STABILITY DERIVATIVES OF THE SPACE SHUTTLE LAUNCH VEHICLE
Richmond P. Boyden, Delma C. Freeman, Jr., and Edwin E. Davenport Washington Feb. 1976 69 p refs
(NASA-TM-X-3315; L-10494) Avail: NTIS HC $4.50 CSCL 22D

An investigation was made to determine the dynamic stability characteristics of a 0.015-scale model of the space shuttle launch vehicle at supersonic speeds. These tests were made at angles of attack from -10 deg to 10 deg at Mach numbers of 2.00, 2.86, 3.96, and 4.63. The complete launch vehicle, consisting

of the orbiter, external tank, and solid rocket boosters, has positive damping in pitch, roll, and yaw over the angle-of-attack and Mach number range. The orbiter external tank configuration has a region of negative angles pitch damping for small negative of attack at a Mach number of 2.00. At all other test conditions, the orbiter external tank configuration has positive damping about all three axes. Author

N76-17177*# Martin Marietta Aerospace, Denver, Colo.
PAYLOAD/ORBITER CONTAMINATION CONTROL REQUIREMENT STUDY Interim Report
L. E. Bareiss and E. B. Ress 31 Jan. 1976 24 p refs
(Contract NAS8-31574)
(NASA-CR-144173; MCR-76-7) Avail: NTIS HC $3.50 CSCL 22B

The Spacelab carrier induced contaminant environment and Spacelab's ability to meet established contamination control criteria for the shuttle program are determined. The primary areas of on-going activity include updating, refining, and improving the Spacelab Contamination Computer Model and contamination analysis methodology; establishing the resulting adjusted induced environment predictions for comparison with the applicable criteria; determining Spacelab design and operational requirements necessary to meet the criteria; conducting mission feasibility analyses of the combined Spacelab/orbiter contaminant environment for specific proposed missions and payload mixes; and establishing a preliminary Spacelab mission support plan and model interface requirements. A summary is given of these activities conducted to date including any modifications in approach or methodology utilized in the contamination assessment of the Spacelab vehicle. The emphasis is placed on the Spacelab modeling efforts. Author

N76-17178*# Battelle Pacific Northwest Labs., Richland, Wash. Math and Physics Research Section.
EXPERIMENT DEFINITION STUDIES FOR AMPS SPACELAB Interim Report
Harold Liemohn Dec. 1975 109 p refs
(Contract NAS8-31415)
(NASA-CR-144172; BN-SA-518) Avail: NTIS HC $5.50 CSCL 14B

The electrical charging of the space shuttle orbiter is discussed in relation to the AMPS Spacelab payload along with an operations research technique for the selection of AMPS Spacelab experiments. Experiments proposed for AMPS include: hydromagnetic wave experiments; bistatic sounder of AMPS wake; and an artificial meteor gun. Experiment objectives and instrument functions are given for all experiments. J.M.S.

N76-17179*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CENTAUR STANDARD SHROUD (CCS) HEATED ALTITUDE JETTISON TESTS
Aug. 1975 238 p refs
(NASA-TM-X-71814; E-8508) Avail: NTIS HC $8.00 CSCL 22D

Altitude jettison tests, at a pressure of 20 torr (0.39 psia), were performed on the Centaur Standard Shroud (CSS) in a 100-foot diameter vacuum chamber. These jettison tests were part of a series of flight qualification tests which were performed on the new CSS system in preparation for the Helios and Viking missions. The first two tests subjected the CSS to a thermal cycle which simulated aerodynamic heating during ascent flight and the third test was performed at altitude pressure and in ambient temperature conditions. The purpose of the ambient temperature test was to provide base line data by which the separate machanical and thermal factors that influence jettison performance could be evaluated individually. The CSS was successfully jettisoned in each of the three tests. Also, thermal, stress, and structural deflection data were obtained which verified the analytical predictions of CSS response to flight environmental conditions and performance during jettison. In addition, much important information was obtained on critical CSS-to-payload clearance losses due to shell motions prior to and during jettison. The effectiveness of the separation system was successfully demonstrated at maximum flight temperatures. Author

N76-17180*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RADIATION ENVIRONMENT AND HAZARDS FOR A GEOSYNCHRONOUS SPACE STATION
J. J. Wright and G. J. Fishman Feb. 1976 34 p refs
(NASA-TM-X-64983) Avail: NTIS HC $4.00 CSCL 22B

An evaluation was made of the potential radiation hazards to the crew and equipment of a geosynchronous space station. Tissue dose rates for electron, bremsstrahlung, galactic cosmic rays, and solar proton events are included for parking longitudes of 110 and 290 degrees at orbit inclinations of 0, 30, and 45 degrees. Author

N76-17181*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.
IN-ORBIT PERFORMANCE OF THE OAO INERTIAL REFERENCE UNIT
Ronald A. Harris 3 Jun. 1974 29 p refs Paper Presented at ION Ann. Meeting, San Diego, Calif., 25-27 Jun. 1974
(Contract NAS5-11002)
(NASA-CR-144724; P-086) Avail: NTIS HC $4.00 CSCL 22B

Performance of the inertial reference unit (IRU) in the Orbiting Astronomical Observatory (OAO-C) is documented. The OAO and IRU are briefly described along with the data reduction programs used to calibrate the IRU in orbit. Application of gyros with good long-term drift stability to future spacecraft such as the Large Space Telescope and Earth Observatory Satellite is discussed. Author

N76-17182*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTIMAL THREE-DIMENSIONAL REUSABLE TUG TRAJECTORIES FOR PLANETARY MISSIONS INCLUDING CORRECTION FOR NODAL PRECESSION
Janos Borsody Washington Feb. 1976 43 p refs
(NASA-TN-D-8168; E-8498) Avail: NTIS HC $4.00 CSCL 22A

Equations are derived by using the maximum principle to maximize the payload of a reusable tug for planetary missions. The analysis includes a correction for precession of the space shuttle orbit. The tug returns to this precessed orbit (within a specified time) and makes the required nodal correction. A sample case is analyzed that represents an inner planet mission as specified by a fixed declination and right ascension of the outgoing asymptote and the mission energy. The reusable stage performance corresponds to that of a typical cryogenic tug. Effects of space shuttle orbital inclination, several trajectory parameters, and tug thrust on payload are also investigated. Author

N76-17183# Naval Research Lab., Washington, D.C.
DESIGN AND GROUND TEST OF THE NTS-1 FREQUENCY STANDARD SYSTEM Final Report
Stephen A. Nichols, Joseph D. White, and Frederick Danzy 5 Sep. 1975 47 p refs
(XF21232651)
(AD-A015084; NRL-7904) Avail: NTIS CSCL 14/2

The NRL TIMATION III satellite, redesignated as GPS Navigation Technology Satellite I (NTS-1) was successfully placed into a medium altitude orbit, 7,300 mi, on July 14, 1974. One of the major experiments performed with the satellite is the investigation of the space-environment performance of two rubidium controlled frequency standards and a specially developed quartz oscillator. System design, ground testing, and flight qualification modifications were performed at NRL. This included modifying commercial-quality rubidium standards to levels acceptable to the flight environment; the design and construction of power control, RF switching, and remote digital tuning circuits; and ground testing the candidate frequency standards in terms of short-term stability (Allen Variance), aging, warmup, tuning characteristics, dc power consumption and environmental effects due to vacuum, radiation, vibration, and temperature. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

No abstracts in this category.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

N76-17184# Lockheed Missiles and Space Co., Palo Alto, Calif.
SOME EXAMPLES OF THE COMBINED ANALYSIS OF SATELLITE IR AND TV INFORMATION
L. I. Kaplina [1975] 5 p refs Transl. into ENGLISH from Tr. Gidrometeorolog. Nauchno-Issled. Tsentr. SSR, Sputnikovaia Meteorol. (USSR), no. 148, 1974 p 53-58
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The simultaneous interpretation of infrared and TV photographs of clouds was analyzed. The picture brightness of the clouds for both the IR and TV photographs is discussed for the cumuloform and stratified clouds. It is shown that considering both kinds of information improve the analysis. F.O.S.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics.*

N76-17185* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SPACE VEHICLE SYSTEM Patent
Maxime A. Faget, William W. Petynia, and Willard M. Taub, inventors (to NASA) Issued 30 Dec. 1975 10 p Filed 5 Mar. 1974 Supersedes N74-33303 (12 - 22, p 2752)
(NASA-Case-MSC-12561-1; US-Patent-3,929,306; US-Patent-Appl-SN-448323; US-Patent-Class-244-162; US-Patent-Class-244-172) Avail: US Patent Office CSCL 22A

A space vehicle system is described which consists of an orbiter vehicle having an expendable propellant tank attached to the underside surface. An engine module is retractably supported from the aft end of the orbiter vehicle and extend so as to be in axial alignment with the propellant tank when in operation. After the engine has consumed the propellant, it is retracted into the orbiter vehicle and the tank is jettisoned thus reducing orbiter weight and improving flight characteristics.
Official Gazette of the U.S. Patent Office

N76-17186*# Sperry Phoenix Co., Ariz. Satellite Programs Dept.
REACTION WHEEL ASSEMBLY Final Report
Jan. 1976 16 p
(Contract NAS8-31385)
(NASA-CR-144168) Avail: NTIS HC $3.50 CSCL 22B

The fabrication and testing of three reaction wheels with associated drive and system monitoring electronics and brushless dc spin motors are discussed; the wheels are intended for use in a teleoperator simulator. Test results are included as graphs.
E.H.W.

N76-17187*# Battelle Columbus Labs., Ohio.
VEHICLE SYSTEMS AND PAYLOAD REQUIREMENTS EVALUATION Final Report, Oct. 1970 - Dec. 1975
F. G. Rea, J. L. Pittenger, R. J. Conlon, and J. D. Allen 23 Dec. 1975 167 p refs
(Contract NAS8-26491)
(NASA-CR-144171) Avail: NTIS HC $6.75 CSCL 22B

Techniques developed for identifying launch vehicle system requirements for NASA automated space missions are discussed. Emphasis is placed on development of computer programs and investigation of astrionics for OSS missions and Scout. The Earth Orbit Mission Program - 1 which performs linear error analysis of launch vehicle dispersions for both vehicle and navigation system factors is described along with the Interactive Graphic Orbit Selection program which allows the user to select orbits which satisfy mission requirements and to evaluate the necessary injection accuracy. J.M.S.

N76-17188# Hercules Powder Co., Magna, Utah. Bacchus Works.
MINUTEMAN STAGE 3 MATERIALS AND COMPONENTS SURVEILLANCE PROGRAM Final Engineering Report, 15 Apr. - 30 Jun. 1975
R. E. Koford 7 Jul. 1975 69 p
(Contract F42600-75-A-0163)
(AD-A015429; MTO-1124-71) Avail: NTIS CSCL 21/8

The report presents the results of Igniter and Frangible Sector tests from the Minuteman Stage 3 motor. The results reported herein were obtained from tests performed during the period 15 April 1975 through 30 June 1975 and are accomplished toward goals detailed in the Minuteman Stage 3 Motor Storage Studies Program Plan, MTO-258-3A, Revision 2, Change 3, Volume I, dated 1 September 1966. The report covers only portion of the Surveillance Aging Program authorized by Ogden ALC Contract F42600-75-A-0163, Tasks 0002 and 0003. Results of effort authorized by ALC concerning aging characteristics of Wings 1 through 6 materials and components are reported.GRA

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N76-17189*# TRW Systems Group, Redondo Beach, Calif.
PRECISION POINTING CONTROL SYSTEM (PPCS) STAR TRACKER TEST Final Technical Report
1 Jul. 1972 28 p refs
(Contract NAS5-21111)
(NASA-CR-144727; TRW-13900-6013-RU-00) Avail: NTIS HC $4.00 CSCL 14B

Tests performed on the TRW precision star tracker are described. The unit tested was a two-axis gimballed star tracker designed to provide star LOS data to an accuracy of 1 to 2 sec. The tracker features a unique bearing system and utilizes thermal and mechanical symmetry techniques to achieve high precision which can be demonstrated in a one g environment. The test program included a laboratory evaluation of tracker functional operation, sensitivity, repeatibility, and thermal stability. Author

N76-17190*# TRW Systems Group, Redondo Beach, Calif.
PRECISION ATTITUDE DETERMINATION SYSTEM (PADS) SYSTEM DESIGN AND ANALYSIS: SINGLE-AXIS GIMBAL STAR TRACKER Final Technical Report
1 Jul. 1974 91 p refs
(Contract NAS5-21111)
(NASA-CR-144726; TRW-13900-6016-RU-00) Avail: NTIS HC $5.00 CSCL 14B

The feasibility is evaluated of an evolutionary development for use of a single-axis gimbal star tracker from prior two-axis

gimbal star tracker based system applications. Detailed evaluation of the star tracker gimbal encoder is considered. A brief system description is given including the aspects of tracker evolution and encoder evaluation. System analysis includes evaluation of star availability and mounting constraints for the geosynchronous orbit application, and a covariance simulation analysis to evaluate performance potential. Star availability and covariance analysis digital computer programs are included. Author

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N76-17191*# Martin Marietta Corp., Baltimore, Md.
EXPLOSIVE AND PYROTECHNIC AGING DEMONSTRATION Final Report, 18 Apr. 1973 - 17 Oct. 1974
Lawrence L. Rouch, Jr. and J. Norman Maycock Washington NASA Feb. 1976 73 p refs
(Contract NAS1-12280)
(NASA-CR-2622) Avail: NTIS HC $4.50 CSCL 21I

The survivability was experimentally verified of fine selected explosive and pyrotechnic propellant materials when subjected to sterilization, and prolonged exposure to space environments. This verification included thermal characterization, sterilization heat cycling, sublimation measurements, isothermal decomposition measurements, and accelerated aging at a preselected elevated temperature. Temperatures chosen for sublimation and isothermal decomposition measurements were those in which the decomposition processess occurring would be the same as those taking place in real-time aging. The elevated temperature selected (84 C) for accelerated aging was based upon the parameters calculated from the kinetic data obtained in the isothermal measurement tests and was such that one month of accelerated aging in the laboratory approximated one year of real-time aging at 66 C. Results indicate that HNS-IIA, pure PbN6, KDNBF, and Zr/KC10 are capable of withstanding sterilization. The accelerated aging tests indicated that unsterilized HNS-IIA and Zr/KC104 can withstand the 10 year, elevated temperature exposure, pure PbN6 and KDNBF exhibit small weight losses (less than 2 percent) and B/KC104 exhibits significant changes in its thermal characteristics. Accelerated aging tests after sterilization indicated that only HNS-IIA exhibited high stability. Author

N76-17192*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE 0.040-SCALE SPACE SHUTTLE ORBITER BASE HEATING MODEL TESTS IN THE LEWIS RESEARCH CENTER SPACE POWER FACILITY
Robert A. Dezelick Jan. 1976 44 p refs
(NASA-TM-X-71843; E-8568) Avail: NTIS HC $4.00 CSCL 21H

Space shuttle base heating tests were conducted using a 0.040-scale model in the Plum Brook Space Power Facility of The NASA Lewis Research Center. The tests measured heat transfer rates, pressure distributions, and gas recovery temperatures on the orbiter vehicle 2A base configuration resulting from engine plume impingement. One hundred and sixty-eight hydrogen-oxygen engine firings were made at simulated flight altitudes ranging from 120,000 to 360,000 feet. Author

N76-17193*# Tulane Univ., New Orleans, La.
TURBULENCE IN A GASEOUS HYDROGEN-LIQUID OXYGEN ROCKET COMBUSTION CHAMBER
J. LeBas, P. Tou, and J. OHara Dec. 1975 29 p refs
(Grant NGR-10-002-030)
(NASA-CR-134909) Avail: NTIS HC $4.00 CSCL 21H

The intensity of turbulence and the Lagrangian correlation coefficient for a LOX-GH2 rocket combustion chamber was determined from experimental measurements of tracer gas diffusion. A combination of Taylor's turbulent diffusion theory and a numerical method for solving the conservation equations of fluid mechanics was used to calculate these quantities. Taylor's theory was extended to consider the inhomogeneity of the turbulence field in the axial direction of the combustion chamber, and an exponential function was used to represent the Lagrangian correlation coefficient. The results indicate that the value of the intensity of turbulence reaches a maximum of 14% at a location about 7' downstream from the injector. The Lagrangian correlation coefficient associated with this value is given by the above exponential expression where alpha = 10,000/ sec. Author

N76-17194*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLID ROCKET THRUST VECTOR CONTROL NASA space vehicle design criteria (chemical propulsion)
Dec. 1974 200 p refs
(NASA-SP-8114) Avail: NTIS HC $7.50 CSCL 21H

Thrust vector control systems that superimpose a side force on the motor thrust, steering being achieved by the side force causing a moment about the vehicle center of gravity are described. A brief review of thrust vector control systems is presented, and two systems, flexible joint and liquid injection, are treated in detail. Treatment of the flexible-joint thrust vector control system is limited to the design of the flexible joint and its insulation against hot motor gases. Treatment of the liquid injection thrust vector control system is limited to discussion of the injectant, valves, piping, storage tanks, and pressurization system; no evaluation is presented of the nozzle except for (1) the effect of the injectant and erosion at the injection port and (2) the effect of injection on pressure distribution within the nozzle. Author

N76-17195# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Propulsion Directorate.
IGNITION TECHNIQUES FOR STUDYING ROCKET SIGNATURE EFFECTS: SMOKE
Robert E. Betts 12 Aug. 1975 12 p
(DA Proj. 1M3-62303-A-214)
(AD-A016876; RK-76-4) Avail: NTIS CSCL 21/8

This report describes an ignition technique whereby rocket motor propellants may be evaluated for smoke production in a quantitative manner with no deleterious effects attributed by the igniter. This technique is also applicable to areas of rocket signature such as flash, IR, RF, and plume studies. The ignition technique is one in which the same propellant being investigated is ground burned at very high pressure with the resulting gases used to ignite the propellant being measured. Author (GRA)

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N76-17196*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
ALDOXIME PEROXIDES (NOTE 3)
R. Ciusa and E. Parisi Washington NASA Jan. 1976 10 p refs Transl. into ENGLISH from Gazz. Chim. Ital. (Rome), v. 55, 1925 p 416-421
(Contract NASw-2789)
(NASA-TT-F-16845) Avail: NTIS HC $3.50 CSCL 07C

A number of stereochemical formulas were proposed in the past for peroxides formed from aromatic addoximes by a variety of means. The validity of these structural form for these compounds was questioned by a number of authors on the basis of various inconsistencies. An alternative formula was presented for these peroxides which appears to correspond to a number of well-known properties of these substances: the liberation of iodine from the iodide, relatively quick explosion under the application of heat, the production of nitrile oxide under the action of alkalis on the chloroximes, and the formation of alpha-dibenzenyloxoaxime by oxidation. Author

N76-17197*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
NITROLIC ACIDS AND ACETYLENE COMPOUNDS. NOTE 7. ON THE FULMINIC SYNTHESIS OF ISOXAZOLES
A. Quilico and M. Simonetta Washington NASA Jan. 1976 15 p refs Transl. into ENGLISH from Gazz. Chim. Ital. (Rome), v. 77, 1947 p 586-595
(Contract NASw-2789)
(NASA-TT-F-16839) Avail: NTIS HC $3.50 CSCL 07C

The synthesis reaction of isoxazole derivatives from nitrolic acids and triple bond compounds is extended, with the suitable experimental technique, to acetylene. Thus synthesized from acetylene and acetylmethylnitrolic acid was gamma-acetylisoxazole (8), and from acetylene and nitroxyiminoacetic ester was gamma-isoxazolcarbonic acid (10). In the case of acylnitrolic acids, their preventive preparation is unnecessary; they can be obtained instead directly from the nitric solution of methylketones. Thus, gamma-benzoylisoxazole (11) was obtained from acetophenone and acetylene in a nitric environment; and it was possible to synthesize gamma-gamma prime-di-isoxazolketone (8) from gamma-acetylisoxazole and acetylene under similar conditions. The theoretical interest of these reactions is emphasized, as they provide an experimental demonstration of the presumed mechanism in the formation of the isoxazolic derivatives in the reaction of HNO3 with non-saturated compounds. Author

N76-17198*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
ON THE EFFECT OF AMYL NITRITE ON OXIMES
Hartwig Franzen and F. Zimmerman Washington NASA Feb. 1976 8 p ref Transl. into ENGLISH from J. Prakt. Chem. (East Ger.), v. 73, no. 2 p 253-256
(Contract NASw-2789)
(NASA-TT-F-16877) Avail: NTIS HC $3.50 CSCL 07C

The reaction products are described which were obtained by reacting various benzaldoximes with amyl nitrite under various experimental conditions, notably in ether and benzene solutions. The results obtained are in good quantitative agreement with the theoretically calculated values for the various reaction products. Author

N76-17199*# Transemantics, Inc., Washington, D.C.
SYNTHESIS OF 3-ALKYLISOXAZOLES
Paulo Vita Finzi Washington NASA Jan. 1976 10 p refs Transl. into ENGLISH from Chim. Ind. (Milan), v. 47, no. 5, 1965 p 516-517
(Contract NASw-2792)
(NASA-TT-F-16866) Avail: NTIS HC $3.50 CSCL 07C

Various 3-alkylisoxazoles were prepared by causing acetonitrile oxides and propionitrile, prepared 'in situ' from the respective nitroalkanes and phenylisocyanate, to react with acetylene compounds. Author

N76-17200# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
BOILING RANGE DISTRIBUTION OF PETROLEUM FRACTIONS BY GAS CHROMATOGRAPHY
G. Moon May 1975 23 p refs Submitted for publication
(AD-A015209; DME-MP-68; NRC-14790; ISSN-0077-555X) Avail: NTIS CSCL 07/3

Gas chromatography has been found to be a useful technique for obtaining more detailed information concerning the boiling range distribution of petroleum fuels than that obtained by the standard distillation procedure. The application of an ASTM procedure, which uses gas chromatographic analysis, to the analysis of wide-cut aviation turbine fuels has been studied by the Fuels and Lubricants Laboratory and the results obtained and comments on the procedure are presented in this report. GRA

N76-17201# Miami Univ., Oxford, Ohio. Dept. of Chemistry.
THE VIBRATIONAL SPECTRA AND STRUCTURES OF ORGANIC ACIDS AND THEIR DERIVATIVES. VOLUME 3: DIMETHYL CARBONATE AND METHYL CYANOACETATE Final Report, 1 Jan. 1973 - 1 Jan. 1975
J. E. Katon, D. Sinha, and M. D. Cohen May 1975 6042 p refs
(Contract F33615-73-C-5013; AF Proj. 7360)
(AD-A014834; AFML-TR-75-19-Vol-3) Avail: NTIS CSCL 07/3

The infrared spectra of dimethyl carbonate in the liquid and solid phases and the Raman spectrum of the liquid phase are reported. It is shown that dimethyl carbonate exists as an equilibrium mixture of at least two conformers in the liquid state. An experimental value for the enthalpy difference of the two conformers is obtained from the temperature dependency of the infrared spectrum. Dimethyl carbonate crystallizes as an oriented polycrystalline film and polarized infrared spectra of the solid have been obtained. These have been used, along with the liquid phase data to obtain an improved vibrational assignment. The infrared spectra of methyl cyanoacetate in both liquid and solid phases and of methyl cyanoacetate-d3 in the liquid phase have been recorded in the region 4000-250/cm. The Raman spectra of both the compounds in the liquid phase have also been recorded. A tentative vibrational assignment has been made both for the liquid and the heavy ester. Evidence is presented for the existence of conformational isomers in the liquid phase. GRA

24 COMPOSITE MATERIALS

Includes laminates.

N76-17202*# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
FABRICATION PROCESS DEVELOPMENT OF SiC/SUPERALLOY COMPOSITE SHEET FOR EXHAUST SYSTEM COMPONENTS Technical Report, 15 Jul. 1974 - 31 Oct. 1975
J. A. Cornie, C. S. Cook, and C. A. Anderson Jan. 1976 47 p refs
(Contract NAS3-18921)
(NASA-CR-134958) Avail: NTIS HC $4.00 CSCL 11D

A chemical compatibility study was conducted between SiC filament and the following P/M matrix alloys: Waspaloy, Hastelloy-X, NiCrAlY, Ha-188, S-57, FeCrAlY, and Incoloy 800. None of the couples demonstrated sufficient chemical compatibility to withstand the minimum HIP consolidation temperatures (996 C) or intended application temperature of the composite (982 C). However, Waspaloy, Haynes 188, and Hastelloy-X were the least reactive with SiC of the candidate alloys. Chemical vapor deposited tungsten was shown to be an effective diffusion barrier between the superalloy matrix and SiC filament providing a defect-free coating of sufficient thickness. However, the coating breaks down when the tungsten is converted into intermetallic compounds by interdiffusion with matrix constituents. Waspaloy was demonstrated to be the most effective matrix alloy candidate in contact with the CVD tungsten barrier because of its relatively low growth rate constant of the intermediate compound and the lack of formation of Kirkendall voids at the matrix-barrier interface. Fabrication methods were developed for producing panels of uniaxial and angle ply composites utilizing CVD tungsten coated filament. Author

N76-17203# Stanford Univ., Calif. Dept. of Materials and Engineering.
DIFFUSION CONTROLLED DEFORMATION OF PARTICULATE COMPOSITES
Glen R. Edwards, Terry R. McNelley, and Oleg D. Sherby Aug. 1975 39 p refs
(Contract N00014-75-C-0662)
(AD-A014922; SU-DMS-75-T-71) Avail: NTIS CSCL 11/4

Unusual mechanical effects at elevated temperatures have been observed in a model composite system of zinc containing large volume fractions (0.05 to 0.30) of small (- 1 micrometer) Al3O3 or W particles. These materials are dispersion-weakened in the temperature range 0.3 T sub m to 0.7 T sub m, and show marked insensitivity of flow stress to changes in strain rate or temperature at about 0.7 T sub m. Strain-aging yield points are also observed at 0.6 T sub m. An explanation for such behavior proposes that, above a threshold stress, mobile dislocations are generated at particle-matrix interfaces by local incompatibility stresses, and that these dislocations have a dominant effect on the nominal flow stress in the region 0.3 to

0.7 T sub m. A constitutive equation reminiscent of the Ansell-Weertman theory for creep of dispersion-strengthened materials is derived from the model, and compared with experimental creep data. GRA

N76-17204# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
BORON-ALUMINUM TITANIUM HYBRID COMPOSITES Final Report, Mar.-Aug. 1974
Erwin Joseph May 1975 46 p refs
(AF Proj. 7351)
(AD-A014795; AFML-TR-74-236) Avail: NTIS CSCL 11/6

Roll diffusion bonded tapes of boron-aluminum were interleaved with foils of commercial pure and alloyed titanium and diffusion bonded into plate material. Tensile testing of both longitudinal and transverse specimens indicated a very small drop in longitudinal strength and a dramatic increase in transverse strength to 48.6 ksi and 67 ksi for the Ti-75A and Ti-6Al hybrid, respectively, for annealed unidirectional composites. These transverse strength increases were considerably in excess of rule of mixtures predictions. Metallographic examination of representative material indicated well spaced and adequately bonded material. Direct comparison with similarly bonded unidirectional and cross-plied boron-aluminum plate indicated that, when considering both mechanical properties and composite cost, considerable advantage could be gained through the use of the hybrid composite studied. GRA

N76-17205# Singer Co., Little Falls, N.J. Kearfott Div.
COMPOSITE TUBES FOR STRUCTURAL USE Final Report, 1 Jul. 1972 - 30 Jun. 1975
Edward J. Hughes and John L. Rutherford 31 Jul. 1975 19 p
(Contract DAHC04-75-C-0048)
(AD-A015564; KD-75-59; ARO-10377.1-E) Avail: NTIS CSCL 13/11

The objective of the program was to determine the mechanical properties of fiber reinforced composite tubes and to compare the results to existent theories used to predict those properties. Graphite/epoxy composite tubes (T300/5209 system) were manufactured and tested in tension, compression and torsion modes as a function of strain rate. The micromechanical properties were measured in each mode using capacitance extensometers. In addition to tubes, tensile tests were performed on strip specimens and rail shear tests on panel specimens. In all of the tests, five prime fiber orientations were used together with various combinations of these orientations. The shear modulus was essentially independent of strain rate whereas the tensile modulus increased by about 8 percent for a fifty-fold increase in strain rate. In the tubular specimens large energy losses were observed in torsion. In tension and compression this did not occur. GRA

N76-17206# Watervliet Arsenal, N.Y.
APPLICATION OF HIGH-STRENGTH FILAMENT REINFORCED METAL MATRIX COMPOSITES TO ADVANCED RAPID FIRE AND HIGH TEMPERATURE BARRELS
I. Ahmad and J. Vasilakis Jul. 1975 115 p refs
(AD-A015460; WVT-TR-75046) Avail: NTIS CSCL 19/6

The feasibility of using high temperature - high strength filament reinforced metal matrix composites to meet the pressure-temperature requirements of 30mm XM140 barrel was evaluated. The technology of the fabrication of metal matrix composite cylinders, involving sequentially filament winding - plasma spraying of the matrix-grinding-winding followed by isostatic densification was developed. New materials including composites of steel wire-bronze, steel wire-316SS TZM wire-316SS were synthesized. The room temperature and elevated temperature burst pressure of composite cylinders, especially those of TZM-316SS with CG 27 liner were measured. A number of dynamic tests of 1500F and 1000F on some of the composite cylinders were made. A cylinder of TZM wire-316SS with CG 27 liner, designed to withstand 30 ksi at 1500F withstood more than 5000 cycles, indicating the feasibility of using composite material under these severe conditions. Technique to overwrap 30mm XM140 barrels with TZM-316SS composite and its densification by hot isostatic pressing was developed. GRA

N76-17207# Naval Weapons Center, China Lake, Calif.
TERMINAL BALLISTICS OF CONCRETE-POLYMER SYSTEMS Final Report, 16 May - Oct. 1974
Kenneth L. Moore and Rowland A. McNeill Sep. 1975 39 p refs
(AD-A014842; AFWL-TR-75-167) Avail: NTIS CSCL 13/3

The terminal ballistic properties of certain concrete-polymer systems have been evaluated. Penetration and cratering measurements were made on three different types of materials: (1) polymer concrete consisting of rock and sand bound by a cured polymer; (2) cured portland cement concrete into which liquid monomers were injected and then cured to varying degrees of polymerization; (3) latex modified concrete which differed from portland cement concrete only in the substitution of latex emulsion for portions of the mix water. Data obtained from impact of 0.30-caliber projectiles indicates that all three systems can produce structural concrete with superior terminal ballistics behavior. Penetration was reduced by up to 30 percent, and cratering by up to 100 percent, with virtual elimination of cracking in the target material. GRA

N76-17208# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy and Materials Science.
AN ANALYTIC METHOD FOR PREDICTING THE FLOW AND FRACTURE IN NOTCHED FIBER COMPOSITE MATERIALS Final Report, 1 Jun. 1974 - 31 May 1975
Lynn J. Ebert and Paul L. Flynn Aug. 1975 128 p refs
(Grant AF-AFOSR-2374-72; AF Proj. 9782)
(AD-A015182; AFOSR-75-1369TR) Avail: NTIS CSCL 11/4

An analytical system was developed for the prediction of the onset and progress of plastic flow, and for the fracture of, oriented fiber composite materials in which both externally applied complex stress states (both biaxial and triaxial) and stress raisers were present. The accuracy of the analytical system was demonstrated by the agreement between analytically predicted and experimentally measured flow values of externally notched tungsten wire reinforced copper composites, in which the fiber fraction was 50% by volume. The predictive system was a unique combination of two numerical analysis systems. First the stresses in the notched composite bars were analyzed by the SAAS II program these stresses were then used as input parameters for a finite element micromechanics program. By applying a yield criterion to the stresses computed by the micromechanics program, it was possible to predict the yielding stresses of the notched composite bars. GRA

N76-17209# Illinois Inst. of Tech., Chicago. Dept. of Metallurgical and Materials Engineering.
FRACTURE TOUGHNESS OF FIBER COMPOSITE MATERIALS Interim Report
L. J. Broutman and S. K. Gaggar Feb. 1975 74 p refs
(Grant AF-AFOSR-2214-72; AF Proj. 9782)
(AD-A015454; AFOSR-75-1393TR) Avail: NTIS CSCL 11/4

Fracture toughness test methods have been evaluated and fracture toughness parameters have been measured for random fiber (discontinuous) composites having epoxy resin matrices. The strength of the glass-resin interface has been altered by using 4 different silane surface treatments applied to the glass fibers. Good agreement between the various test methods has been obtained and reliable techniques have been developed to measure the fracture toughness. Damage mechanisms at the crack tip have been investigated and comparison of experimentally determined values of fracture toughness with theoretical predictions are being made in order to better understand the parameters controlling energy absorption in composites. GRA

N76-17210# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
THE EFFECT OF FREQUENCY AND STRAIN AMPLITUDE ON THE FATIGUE DAMAGE OF BORON/EPOXY FIBER-REINFORCED COMPOSITE MATERIALS Interim Report
R. S. Williams, K. L. Reifsnider, W. W. Stinchcomb, and H. T. Turgay Apr. 1975 65 p refs
(Grant AF-AFOSR-2358-72; AF Proj. 9782)
(AD-A015479; AFOSR-75-1387TR) Avail: NTIS CSCL 11/4

The results of strain-controlled axial fatigue tests on boron/epoxy fiber reinforced composite materials are presented in the first of a series of reports detailing such results for a

large number of fatigue tests run on boron/epoxy and boron/aluminum. The report contains a complete discussion of present experimental methods used in conjunction with this research program. Data from a series of undamaged (virgin) cyclic stress/strain tests at various frequencies, a series of strain controlled fatigue tests at 30Hz cyclic loading at several strain amplitudes and a series of constant strain amplitude fatigue tests at various frequencies (including all specimen and testing specifications) is presented and discussed at length. The effect of cyclic frequency on fatigue damage development is discussed and other pertinent trends are indicated. GRA

N76-17211# Artech Corp., Falls Church, Va.
FABRICATION AND TESTING OF SAPPHIRE FILAMENT REINFORCED SUPERPLASTIC Ni-Cr-Fe ALLOY COMPOSITES Final Report, Jul. 1973 - Feb. 1975
Paul J. Lare, Fred Ordway, and Henry Hahn May 1975 36 p
(Contract N00019-74-C-0033)
(AD-A016303; J7308-FR) Avail: NTIS CSCL 11/4

Experimental efforts to fabricate composite samples of a Ni-Cr-Fe alloy reinforced with Al2O3 filaments are described. Sapphire filament/polystyrene layup sheets were sandwiched between sheets of Incoloy 809E matrix and consolidated in a vacuum hot press under conditions at which the matrix demonstrated superplasticity. The resulting samples were evaluated metallographically and, where possible, mechanically for completeness of consolidation. Although the feasibility of consolidation was demonstrated without the use of photochemically etched positioning grooves in the matrix, limitations of the technique were identified and found related to the hot press die design and load applying components as well as the variability of the sapphire filaments. GRA

N76-17212# Advisory Group for Aerospace Research and Development, Paris (France).
FAILURE MODES OF COMPOSITE MATERIALS WITH ORGANIC MATRICES AND THEIR CONSEQUENCES ON DESIGN
G. C. Leomand (Soc. Natl. Ind. Aerospatiale, Les Mureaux) Oct. 1975 8 p
(AGARD-AR-86) Avail: NTIS

Theoretical and experimental data on fracture mechanisms of composite materials with organic matrices are reported along with practical avoidance methods for designers. Data cover the following areas: propagation of cracks in composites, behavior of ply reinforced fabric, and behavior of assembly plies. Temperature and design effects and test equipment are also discussed. Author

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

N76-17213 California Univ., San Diego.
AN ASYMPTOTIC APPROACH TO GAS-PHASE IGNITION THEORY Ph.D. Thesis
Manuel Kindelan 1975 266 p
Avail: Univ. Microfilms Order No. 76-2303

An asymptotic analysis is presented for the ignition of a solid fuel that gasifies endothermically then reacts exothermically in the gas phase through a one-step Arrhenius process. The gasification process is analyzed by assuming that the ratio of the thermal energy to the activation energy for gasification is a small parameter. It is found that an initial stage of inert heat conduction is separated from a final stage of transport controlled gasification by a short transition stage. The gasification reaction is assumed to take place at the surface, but the analysis is extended to account for a distributed gasification reaction and in-depth absorption of radiation. The results are presented in parametric form and used to indicate how ignition by gas-phase reactions may be distinguished experimentally from ignition by condensed-phase or heterogeneous reactions. Dissert. Abstr.

N76-17214*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FEASIBILITY DEMONSTRATION FOR HYDROGEN CHLORIDE DETECTION USING A CHEMISORPTION TECHNIQUE AND A QUARTZ CRYSTAL MICROBALANCE
David W. Jex and Gary L. Workman (Athens Coll.) Dec. 1975 20 p refs
(NASA-TM-X-64984) Avail: NTIS HC $3.50 CSCL 07D

A method of measuring concentrations of hydrogen chloride between 1 part per billion and 10 parts per million at standard temperature and pressure is presented. The feasibility of a low-cost device incorporating a chemisorption technique coupled with a quartz crystal microbalance was demonstrated in the field at the Viking B launch using a Titan-Centaur vehicle from Kennedy Space Center on August 20, 1975. Hydrogen chloride is a product of solid rocket combustion. The concentration level of hydrogen chloride for this particular launch was measured as approximately 0.2 parts per million at 4 km from the launch site. Author

N76-17215*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
HIGH PRESSURE LIQUID AND GASEOUS OXYGEN IMPACT SENSITIVITY EVALUATION OF MATERIALS FOR USE AT KENNEDY SPACE CENTER
Coleman J. Bryan Washington Feb. 1976 88 p refs
(NASA-TN-D-8160; MTB-190-71) Avail: NTIS HC $5.00 CSCL 21B

The sensitivity of materials in contact with gaseous oxygen (GOX) or liquid oxygen (LOX) was examined. Specifically, the reactivity of materials when in contact with GOX or LOX if subjected to such stimuli as mechanical impact, adiabatic compression (pneumatic impact), or an electrical discharge in the form of a spark were examined. Generally, materials are more sensitive in gaseous oxygen than in liquid oxygen and impact sensitivity is known to increase with increasing pressure. Materials presently being used or considered for use in oxygen systems at KSC were evaluated. Results are given in tabular form. Author

N76-17216*# National Aeronautics and Space Administration. Pasadena Office, Calif.
PHOTON EXCITED CATALYSIS Patent Application
Melvin M. Saffren, inventor (to NASA) (JPL) Filed 29 Jan. 1976 12 p
(Contract NAS7-100)
(NASA-Case-NPO-13566-1; US-Patent-Appl-SN-653316) Avail: NTIS HC $3.50 CSCL 07D

A catalytic procedure for increasing the yield of photonically initiated gas phase chemical reactions is described. The procedure involves the extraction of excess energy from unstable excited species by contacting the species with the surface of a finely divided solid. NASA

N76-17217# Illinois Univ., Urbana. Dept. of Chemical Engineering.
COMBUSTION AND FLAME STABILITY Final Report, 15 Apr. 1973 - 15 Jun. 1975
Roger A. Schmitz 14 Aug. 1975 14 p refs
(Contract DAHC04-73-C-0020)
(AD-A015585; ARO-11123.2-E) Avail: NTIS CSCL 21/2

This report describes research undertaken to obtain a better understanding, for engineering and design purposes, of the behavioral characteristics of open combustible systems and of the roles and interactions of the various physical and chemical rate processes that are involved. The project on which this report mainly focuses is the stabilization, by feedback control, of steady states that are intrinsically unstable in a well-mixed combustor. Aside from being of fundamental interest in themselves, such stabilized states would apparently permit a more detailed study of combustion kinetics and of the nature of exothermic reacting flows than is otherwise possible. Results showing some computer-simulated stabilized states as well as experimental ones are presented. GRA

N76-17218# Maryland Univ., College Park. Dept. of Physics and Astronomy.
PROGRESS REPORT ON THE MEASUREMENT OF THE CRITICAL EXPONENT ETA OF A BINARY LIQUID MIXTURE NEAR ITS CRITICAL MIXING POINT
R. F. Chang and H. Burstyn Sep. 1975 25 p refs
(Contract N00014-67-A-0239-0014)
(AD-A015280; TR-76-040) Avail: NTIS CSCL 07/4

Measurements were made on the scattering intensity of a binary liquid mixture near its critical mixing point. Effects of turbidity and double scattering are taken into account before comparing the data with phenomenological scaling functions proposed by Fisher and Burford and by Ferrell and Scalapino. The result shows that eta is non-zero. Difficulties encountered in the precise determination of eta are discussed. GRA

N76-17219# Colorado State Univ., Fort Collins. Dept. of Chemistry.
A THEORETICAL TREATMENT OF STAIRCASE VOLTAMMETRIC STRIPPING FROM THE THIN FILM MERCURY ELECTRODE
Joseph H. Christie and Robert A. Osteryoung Sep. 1975 21 p refs
(Contract N00014-76-C-0092; NR Proj. 359-493)
(AD-A015235; TR-4) Avail: NTIS CSCL 07/4

Staircase voltammetric stripping is an attractive alternative to both differential pulse and linear scan voltammetric stripping. This paper presents a theoretical treatment of this new stripping mode applied to the thin-film mercury electrode. For equivalent scan rates the faradaic response is somewhat smaller than that obtained by linear scan stripping. GRA

N76-17220# Oklahoma State Univ., Stillwater. Stillwater Research Foundation.
IMPROVEMENTS, EXTENSIONS AND APPLICATIONS OF THE METHOD OF TIGHT BINDING
Earl E. Lafon, Richard Heaton, and Paul Kervin Wright-Patterson AFB, Ohio ARL Jun. 1975 52 p refs
(Contract F33615-71-C-1395; AF Proj. 7885)
(AD-A014739; ARL-75-0197) Avail: NTIS CSCL 07/4

Improved methods are presented for applying the method tight binding (LCAO) along with specific applications to bulk properties which can be compared directly with experiment. Such bulk properties as x-ray form factors, density of states, optical dielectric response, x-ray absorption, and Compton profile are investigated with specific applications to diamond, silicon and lithium fluoride in order to permit direct comparison with experiment. Additionally, the validity and quantitative accuracy of such concepts as the covalent bond description of the valence bands of diamond and silicon are investigated. GRA

N76-17221# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
SECONDARY ION MASS SPECTROMETRY
K. F. J. Heinrich and D. E. Newbury Oct. 1975 233 p refs Proc. of a Workshop on Secondary Ion Mass Spectrometry and Ion Microprobe Mass Analysis, Gaithersburg, Md., 16-18 Sep. 1974
(COM-75-11398/5; NBS-SP-427; LC-75-619223) Avail: NTIS HC $8.00 CSCL 07D

This book is the formal report of the Workshop on Secondary Ion Mass Spectrometry (SIMS) and Ion Microprobe Mass Analysis held at the National Bureau of Standards in September 1974. Invited and contributed papers cover a range of topics in the SIMS field: design of SIMS instrumentation; factors affecting secondary ion collection; techniques of reducing secondary ion mass spectra to yield quantitative compositional information; comparisons of SIMS with Auger electron spectroscopy (AES); techniques of obtaining elemental depth profiles; the instrumental and physical factors affecting such profiles; and applications of SIMS to the study of geological samples. GRA

N76-17222# Monsanto Research Corp., Dayton, Ohio.
TRACE ANALYSIS FOR METALS IN AEROSPACE MATERIALS BY GAS CHROMATOGRAPHY Final Report, 1 Feb. 1972 - 1 Jan. 1975
William D. Ross, Leo Parts, Marilyn S. Black, and Mark T. Winninger Jun. 1975 93 p refs
(Contract F33615-72-C-1304; AF Proj. 7023)
(AD-A016760; MRC-DA-441; ARL-75-0189) Avail: NTIS CSCL 07/4

Contents: Analysis for beryllium in the environment by gas chromatography-(Analysis for beryllium in ambient air particulates by gas chromatography, Analysis for beryllium in soil, coal fly ash, coal, and wheat straw); Analysis for chromium by gas chromatography, (Analysis for chromium in lunar material by gas chromatography, Chromium extraction studies, Analysis for chromium in nbs coal and fly ash); An assessment of instrumentation and monitoring needs for significant pollutants emitted by air force operations and recommendations for future research on analysis of pollutants; Development and evaluation of an atmospheric pressure microwave excited emission detector for gas chromatography; Extraction of beta-Diketones from wheat plant wax-(Extraction of wax from green wheat straw, Evaluation of separation and identification techniques, and the Extraction of components of dry wheat straw). GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N76-17223+ Ugine Aciers, Ugine (France).
FATIGUE DETERIORATION MECHANISMS BY ROLLING-SLIDING Final Report [ETUDES DES MECANISMES DE DETERIORATION PAR FATIGUE EN ROULEMENT-GLISSEMENT]
D. Rousseau Oct. 1974 85 p refs In FRENCH; ENGLISH summary
(Contract DGRST-72-7-0332)
Avail: NTIS HC $5.00

Contact fatigue experiments were performed under both pure rolling and combined rolling and sliding conditions with a bearing steel (100C6) and with a case-hardening steel (20 NCD2). These tests have shown that, even with low surface roughness as compared with lubricating conditions, occurrence of some sliding action lowers contact fatigue resistance, promotes new nucleation mechanisms of spalling, and sweeps away any effect of steel melting practice upon endurance. It is, however, likely that endurance is affected by some other metallurgical parameters, especially grain size. Author (ESA)

N76-17224*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COREST: A FORTRAN COMPUTER PROGRAM TO ANALYZE PARALINEAR OXIDATION BEHAVIOR AND ITS APPLICATION TO CHROMIC OXIDE FORMING ALLOYS
Charles E. Barrett and Alden F. Presler Washington Feb. 1976 81 p refs
(NASA-TN-D-8132; E-8432) Avail: NTIS HC $5.00 CSCL 11F

A FORTRAN computer program (COREST) was developed to analyze the high-temperature paralinear oxidation behavior of metals. It is based on a mass-balance approach and uses typical gravimetric input data. COREST was applied to predominantly Cr_2O_3-forming alloys tested isothermally for long times. These alloys behaved paralinearly above 1100 C as a result of simultaneous scale formation and scale vaporization. Output includes the pertinent formation and vaporization constants and kinetic values of interest. COREST also estimates specific sample weight and specific scale weight as a function of time. Most importantly, from a corrosion standpoint, it estimates specific metal loss. Author

N76-17225*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMOGRAVIMETRIC STUDY OF REDUCTION OF OXIDES PRESENT IN OXIDIZED NICKEL-BASE ALLOY POWDERS
Thomas P. Herbell Washington Jan. 1976 18 p refs
(NASA-TM-X-3340; E-8492) Avail: NTIS HC $3.50 CSCL 11F

Carbon, hydrogen, and hydrogen plus carbon reduction of three oxidized nickel-base alloy powders (a solid solution

strengthened alloy both with and without the gamma prime formers aluminum and titanium and the solid solution strengthened alloy NiCrAlY) were evaluated by thermogravimetry. Hydrogen and hydrogen plus carbon were completely effective in reducing an alloy containing chromium, columbium, tantalum, molybdenum, and tungsten. However, with aluminum and titanium present the reduction was limited to a weight loss of about 81 percent. Carbon alone was not effective in reducing any of the alloys, and none of the reducing conditions were effective for use with NiCrAlY. Author

N76-17226# Advisory Group for Aerospace Research and Development, Paris (France).
MANUAL ON FATIGUE OF STRUCTURES. VOLUME 2: CAUSES AND PREVENTION OF STRUCTURAL DAMAGE. CHAPTER 6: FRETTING; CORROSION DAMAGE IN ALUMINIUM ALLOYS
William G. Barrois Nov. 1975 89 p refs
(AGARD-MAN-9-Vol-2) Avail: NTIS HC $5.00

The question of damage due to fatigue, fretting, corrosion, and stress corrosion is discussed in detail. The causes of failure are outlined, along with the characteristics of electrochemical corrosion. Prevention of and protection against stress corrosion and electrochemical corrosion were investigated. For individual titles, see N76-17227 through N76-17229.

N76-17227 Advisory Group for Aerospace Research and Development, Paris (France).
OUTLINE OF THE CAUSES OF FAILURE
In its Manual on Fatigue of Struct., Vol. 2, Chapter 6 Nov. 1975 p 1-25 (For availability see N76-17226 08-26)

The causes of failure are discussed; these include surface damage and low temperature brittleness. Remedies against wear, seizure, galling and fretting are presented along with the effects of fatigue, alloying elements, heat-treatments and ageing on low temperature brittleness. M.J.S.

N76-17228 Advisory Group for Aerospace Research and Development, Paris (France).
ELECTROCHEMICAL CORROSION
In its Manual on Fatigue of Struct., Vol. 2, Chapter 6 Nov. 1975 p 25-50 (For availability see N76-17226 08-26)

The theory of chemical corrosion was investigated in detail along with actual corrosion, protection against corrosion, and action against corrosion. M.J.S.

N76-17229 Advisory Group for Aerospace Research and Development, Paris (France).
STRESS CORROSION OF ALUMINUM ALLOYS
In its Manual on Fatigue of Struct., Vol. 2, Chapter 6 Nov. 1975 p 50-71 refs (For availability see N76-17226 08-26)

Intergranular corrosion and stress corrosion cracking were studied along with cracking mechanisms in aluminum alloys and data and tests relating to those alloys. Progress in stress corrosion testing is reported, and ways of preventing stress corrosion cracking are included. M.J.S.

N76-17230# Materials Research Labs., Maribyrnong (Australia).
IMPACT TESTING AND STRAIN-AGE EMBRITTLEMENT OF FRENCH AND BHP STEEL STRIP FOR THE DEFA 30 mm PROJECTILE
C. W. Weaver Aug. 1975 53 p refs
(MRL-639) Avail: NTIS HC $4.50

The effects of notch configuration and specimen size on Charpy impact properties, using a 0.2% plain carbon French steel are examined. An impact test specification was established for substandard V-notched Charpy impact specimens taken from 6 mm thick steel strip, based on the existing French specification which uses 10 mm U-notch Charpy. The effect of changing the notch configuration from a U-notch to a Charpy V-notch in both 10 mm and 4 mm wide specimens was to raise the brittle-ductile transition temperature of the steel (as normalized) above - 29 C, thus rendering the French specification requirement for retained impact properties at - 20 C inoperative. A meaningful specification at - 20 deg and + 20 C could be derived, however, for 4 mm wide impact specimens by applying a quench and temper heat treatment. The effects of strain aging were also investigated on a sample of local steel strip (BHP). The COD testing on 4 mm wide double notched impact specimens showed the detrimental effects of a high nonmetallic inclusion content on impact properties. Author

N76-17231*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HEAT TREATING OF A LAMELLAR EUTECTIC ALLOY (GAMMA/GAMMA PRIME + DELTA)
S. N. Tewari and R. L. Dreshfield 1976 22 p refs Proposed for presentation at Intern. Gas Turbine Conf., New Orleans, 21-25 Mar. 1976; sponsored by ASME
(NASA-TM-X-71833; E-8531) Avail: NTIS HC $3.50 CSCL 11F

Eutectic superalloys are being developed at several laboratories for application as aircraft gas turbine airfoils. One such alloy was subjected to several heat treatments to determine if its mechanical properties could be improved. It was found that by partially dissolving the alloy at 1210 C and then aging at 900 C the tensile strength can be increased about 12 percent at temperatures up to 900 C. At 1040 C no change in tensile strength was observed. Times to rupture were measured between 760 and 1040 C and were essentially the same or greater than for as-grown material. Tensile and rupture ductility of the alloy are reduced by heat treatment. Photographs of the microstructure are shown. Author

N76-17232*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ALLOY SOFTENING IN BINARY IRON SOLID SOLUTIONS
Joseph R. Stephens and Walter R. Witzke Washington Feb. 1976 30 p refs
(NASA-TN-D-8167; E-8479) Avail: NTIS HC $4.00 CSCL 11F

An investigation was conducted to determine softening and hardening behavior in 19 binary iron-alloy systems. Microhardness tests were conducted at four temperatures in the range 77 to 411 K. Alloy softening was exhibited by 17 of the 19 alloy systems. Alloy softening observed in 15 of the alloy systems was attributed to an intrinsic mechanism, believed to be lowering of the Peierls (lattice friction) stress. Softening and hardening rates could be correlated with the atomic radius ratio of solute to iron. Softening observed in two other systems was attributed to an extrinsic mechanism, believed to be associated with scavenging of interstitial impurities. Author

N76-17233*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TANTALUM MODIFIED FERRITIC IRON BASE ALLOYS
Patent Application
Robert E. Oldrieve and Charles P. Blakenship, inventors (to NASA) Filed 21 Jan. 1976 10 p
(NASA-Case-LEW-12095-1; US-Patent-Appl-SN-651009) Avail: NTIS HC $3.50 CSCL 11F

Improved iron based alloys with ferritic body centered cubic microstructures are reported. The alloys are of the Fe-Cr-Al type and have high temperature and oxidation resistance properties in the 800 C to 1040 C range. The application of these alloys to furnace linings and flue stacks was discussed. NASA

N76-17234# Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF THE ANODIC DISSOLUTION OF METALS ON A ROTATING DISC ELECTRODE WITH A RING
L. F. Kozin, K. K. Lepesov, and E. E. Kobrand [1975] 14 p refs Transl. into ENGLISH from the book "Tr. Kinetika i Mekhanizm Elektrodnykh Reaktsii" Alma-Ata, NAUKA (KazSSR), 1975 p 3-15
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Electrometallurgical mechanisms and anodic dissolution of metals were discussed. Cathodic reduction, ionization mechanisms of metals with different metals, and discharge are covered. Author

N76-17235# TRW, Inc., Cleveland, Ohio.
INHIBITION OF HYDROGEN EMBRITTLEMENT IN HIGH STRENGTH STEEL
C. S. Kortovich Jul. 1975 25 p refs

(Contract N00014-74-C-0365)
(AD-A014654; TRW-ER-7814-1) Avail: NTIS CSCL 11/6

This report involved a study of the effect of rare earth additions on the hydrogen embrittlement resistance of 4340 steel. Attempts were made in this study to improve the hydrogen embrittlement and stress corrosion resistance of hydrogenated 4340. GRA

N76-17236# Frankford Arsenal, Philadelphia, Pa.
THERMOMECHANICAL PROCESSING OF ALUMINUM ALLOY INGOTS
J. Waldman, H. Sulinski, and H. Markus Aug. 1975 37 p refs Presented at the 21st Sagamore Army Mater. Res. Conf., Sagamore, N. Y., 13-16 Aug. 1974
(DA Proj. 1T1-62105-AH-85)
(AD-A014980; FA-TA-75052) Avail: NTIS CSCL 11/6

The Materials Engineering Division at Frankford Arsenal is involved in an extensive research effort aimed at upgrading the engineering properties of wrought high strength 7000 series aluminum alloys through thermomechanical processing of the ingot material. The development of two new ingot thermomechanical processing techniques, ISML-ITMT and FA-ITMT, is presented. The effects of these techniques on the recrystallization behavior, grain morphology, tensile properties, fracture toughness and stress corrosion resistance of high purity 7075 alloy sheet and plate is presented. The recrystallization of 7075 alloy into a fine grained material was found to be controlled by the distribution of the major alloying elements, Zn, Mg and Cu, as well as by that of the ancillary element, Cr. The results showed that for a given standard temper, i.e., T6, T76 and T73, high purity ITMT processed 7075 alloy has finer grain size, equivalent strength and better ductility, fracture toughness and stress corrosion characteristics than commercial 7075 alloy. The work also showed that high purity ITMT processed 7075 alloy in the FTMT temper (a temper involving a deformation stage between an initial and a final artificial aging stage) has higher strength, ductility and fracture toughness than commercial 7075-T6 alloy.
Author (GRA)

N76-17237# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Ground Equipment/ Materials Directorate
NONLINEAR ANALYSES OF THE STRESS FIELD NEAR A CRACK OR HOLE IN A PLATE
Kenneth W. Suits 18 Aug. 1975 125 p refs
(AD-A014982; RL-76-3) Avail: NTIS CSCL 11/6

Two methods for obtaining a complete stress field about a hole or crack in a plate were developed. Emphasis was placed on the effect of including the nonlinear terms in the strain-displacement equations. An analytical theory for a nonlinear crack problem was presented along with a nonlinear finite element approach to the problem of a plate with a centrally located hole. The plate was loaded in tension and the two-dimensional solution was based on an incremental theory of plane stress. Elaborate programs were written making use of the modern computer to solve the lengthy algebraic statements associated with the plate containing cracks and cutouts subjected to a loaded condition. Appropriate verification curves were plotted indicating the deviation between existing linear theories and the presented theories utilizing nonlinear considerations. These curves indicated the inaccuracy of linear solutions in the immediate crack-tip vicinity and also near a hole boundary. Complete stress fields were obtained for the two methods and corresponding stress curves were plotted. Author (GRA)

N76-17238# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DETERMINATION OF STRESS INTENSITY FACTOR FOR COLD-WORKED FASTENER HOLES IN 7075 ALUMINUM USING THE CRACK GROWTH METHOD M.S. Thesis
William H. Cathey May 1975 111 p refs
(AD-A015002; GAE/MC/74-2; AFML-TR-74-283) Avail: NTIS CSCL 11/6

Stress intensity factor calibrations were obtained for thru-the-thickness flaws emanating from cold-worked fastener holes in 7075-T6 aluminum alloy plate using the fatigue crack growth method. Cracks were periodically photographed to determine crack growth rate using a 35 mm camera actuated by a digital counter. Tests were conducted in laboratory air with constant amplitude loading, 30 Hz frequency, and R-factor = 0.05. The J.O. King sleeved cold-working process was used with a nominal diametral interference of 0.012 in. Open-hole specimens were tested at 16 KSI, 25 KSI, and 40 KSI remote stress. The K calibrations for open cold-worked holes were in agreement with Grandt's linear superposition solution. Pin-loaded cold-worked holes, tested using a 2000 lb load transferred thru a 0.25 in. pin, showed a twenty-fold increase in fatigue life. GRA

N76-17239# Watervliet Arsenal, N.Y.
THE EFFECT OF AUSTENITIZATION SOAK TIMES ON MECHANICAL PROPERTIES
P. Dembowski and R. Griffin Aug. 1975 28 p refs
(AD-A015532; WVT-TR-75049) Avail: NTIS CSCL 13/8

The effect of austenitization soak time on the mechanical properties and microstructure of a Cr-Ni-Mo steel was investigated. It was found that for each of two temperatures (843C and 954C) soak times of ten minutes yielded results essentially equivalent to soak times of 60 minutes. Specimens austenitized at a temperature of 843C (1550F) exhibited slightly better mechanical properties than those austenitized at 954C (1750). GRA

N76-17240# California Univ., Los Angeles. Dept. of Materials.
EFFECT OF HYDROGEN ON INTERNAL FRICTION OF SEVERAL Ti ALLOYS
Norman L. Guiles and Kanji Ono Aug. 1975 12 p refs
(Contract N00014-67-C-0439)
(AD-A015546) Avail: NTIS CSCL 11/6

A resonant bar apparatus employing a three-component piezoelectric composite oscillator system was used to make internal friction and modulus measurements in several titanium alloys in the range of 80 to 400K. Emphasis was placed on the alpha plus beta alloy, Ti-6Al-4V, but the study also included pure Ti, Ti-Al alloys (1, 3 and 10 at.%), Ti-6Al-6V-2Sn, Ti-8Al-1Mo-1V and Ti-17.5Mo alloys. The effect of hydrogen impurities on internal friction was investigated, and a Snoek-type relaxation peak was observed in beta-containing alloys. In the case of Ti-6Al-4V, the peak was found at 144K in the kilohertz frequency range with a relaxation strength of 0.0035/at.% hydrogen. The peak was absent in pure Ti, Ti-Al alloys or quenched Ti-6Al-4V alloy, indicating the need of bcc lattice. The peak was also observed using 10MHz pulse-echo internal friction measurements at 195K. GRA

N76-17241# Florida Univ., Gainesville. Dept. of Materials Science and Engineering.
MECHANISMS AND INHIBITION OF DEALLOYING IN AN ALPHA BRASS
William Clarence Fort, III Aug. 1975 214 p refs
(Contracts N00014-75-C-0820; N00014-68-A-0173-0015; NR Proj. 036-092)
(AD-A015097) Avail: NTIS CSCL 11/6

Dealloying of a single-phase binary alpha brass in ph 4, 0.1 M chloride solution was investigated in terms of the operative mechanism. Selective leaching of zinc from the brass was produced under conditions of cathodic polarization. Auger electron spectroscopy was employed to measure composition versus depth profiles of the resulting zinc-depleted surface layers. The selective leaching mechanism was found to be based on enhanced volume diffusion of zinc to the brass surface. Dealloying by dissolution of the brass as a whole, followed by redeposition of the copper, was found to occur exclusively under occluded cell conditions. The mechanism was examined in terms of the copper-chloride equilibria established at the dissolving brass surface. The redeposition of copper was found to proceed by reduction of cuprous chloride near the brass surface. The inhibitive effect of arsenic was determined to be the prevention of the cuprous chloride reduction reaction. GRA

N76-17242# Naval Research Lab., Washington, D.C.
EVALUATION OF FATIGUE CRACK-GROWTH-RATE DETERMINATION USING A CRACK-OPENING DISPLACEMENT TECHNIQUE FOR CRACK-LENGTH MEASUREMENT Final Report
A. M. Sullivan and T. W. Crooker 12 Sep. 1975 29 p refs

(NRL Proj. M01-24; RR0220146)
(AD-A015305; NRL-7912) Avail: NTIS CSCL 11/6

Evaluation of a crack-opening-displacement (COD) technique for measurement of crack length in compact tension (CT) specimens for the determination of fatigue crack growth rate (FCGR) has proved it to be successful. Comparisons of COD-determined FCGR data with previously established trend lines for two high-strength steels are presented together with data from aluminum alloy 2024-T351. GRA

N76-17243# Rice Univ., Houston, Tex. Dept. of Mechanical Engineering.
THERMODYNAMIC AND KINETIC PROPERTIES OF SOLUTE ATOMS IN INTERSTITIAL SOLID SOLUTIONS Final Report, 1 Jun. 1972 - 31 May 1975
Rex B. McLelland 5 Aug. 1975 13 p refs
(Grant DA-ARO(D)-31-124-72-G145)
(AD-A015594; ARO-10119.5-MC) Avail: NTIS CSCL 11/6

An apparatus has been constructed which enables the variation in the Young's modulus of interstitial solid solutions to be measured at high temperatures (above 1000C) as a function of concentration. Such measurements have been carried out for C-austenite at 1000C and 1150C. The results have been used to estimate the strength of the C-C interaction in fcc iron. The variation with temperature of the solubility of hydrogen in a series of metals and metal solid solutions has been measured. The solubility data have been used to estimate the thermodynamic functions of the dissolved hydrogen and compare these functions with those predicted by theoretical models for hydrogen-metal solutions. GRA

N76-17244# Watervliet Arsenal, N.Y.
EVALUATION OF 410 STAINLESS STEEL PRODUCED BY THE WATTS PROCESS
Vito J. Colangelo and Gary P. Lessen Mar. 1975 21 p refs
(AD-A015533; WVT-TN-75013) Avail: NTIS CSCL 11/6

A preliminary investigation was undertaken to compare the properties obtainable in a 410 stainless steel produced by the Watts Process with those of a conventionally cast 410 stainless steel alloy. Material produced by the Watts Process was subjected to two different heat treatments, both prior to and subsequent to forging. Microstructure, soundness and surface were evaluated. GRA

N76-17245# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
EVALUATION OF SERMETEL W COATING FOR FASTENERS Progress Report
M. J. Zurko 11 Jul. 1975 40 p refs
(AD-A016809; NADC-75121-30) Avail: NTIS CSCL 13/5

The evaluated coating SermeTel W with Alodine 407-47 conversion coating is intended for use on titanium fasteners, fasteners in titanium structures and alloy steel fasteners in temperature environments beyond cadmium coating capabilities. The cadmium coating is not acceptable for titanium application since titanium fasteners or titanium structures in contact with cadmium are susceptible to cracking when highly stressed even at temperatures well below 450 F. The investigation in this report included reusability (locking torques), torque-tension relationship, tension-tension fatigue, salt spray, coating thickness and coating continuity. The test results of samples coated with SermeTel W were compared with cadmium coated samples and were found to be suitable for alloy steel fasteners which are in contact with titanium structures or are exposed to temperatures above 450 F. GRA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N76-17246 Tennessee Univ., Knoxville.
BLOCK COPOLYMERS BASED ON WHOLLY AROMATIC POLYAMIDE AND POLY(ETHYLENE OXIDE) OR POLY (DIMETHYL SILOXANE) SEGMENTS Ph.D. Thesis
Richard Jaroslav Zdrahala 1975 173 p
Avail: Univ. Microfilms Order No. 76-1997

The synthesis and certain physical-mechanical properties were studied of block copolymers containing aromatic polyamide segments. In addition to the influence of cosegments on tensile properties, their effect on both solubility characteristics and morphology were studied. Poly(m-phenylene isophthalamide) prepolymers were used in combination with poly(ethylene oxide) or poly(dimethyl siloxane) homopolymers for the formation of these block copolymers. A series of 18 poly(m-phenylene isophthalamide) homopolymers, 30 poly(m-phenylene isophthalamide-b-ethylene oxide) block copolymers and 22 poly(m-phenylene isophthalamide-b-dimethyl siloxane) block copolymers were synthesized. A low temperature, self-regulating copolycondensation technique was designed and modified for formation of these interesting polymeric materials. Molecular-level properties, (viscosity-molecular weight, solubility and composition) were determined for all the above mentioned polymers. The improved solubility of block copolymers containing poly(ethylene oxide) segments in comparison with poly(m-phenylene isophthalamide) homopolymer was determined. Physical and mechanical properties, including thermal stability, tensile strength, Young's modulus, elongation and thermomechanical behavior, were measured for all synthesized materials. Dissert. Abstr.

N76-17247*# Princeton Univ., N.J. Dept. of Chemical Engineering.
INVESTIGATION OF STRUCTURE-PROPERTY RELATIONSHIPS IN SYSTEMATIC SERIES OF NOVEL POLYMERS Final Report
J. K. Gillham Feb. 1976 45 p refs Sponsored in part by Office of Naval Res.
(Grant NGR-31-001-221)
(NASA-CR-146417) Avail: NTIS HC $4.00 CSCL 11G

Solid state transitions in polymeric materials was associated with the onset of sub-molecular motions of the polymer chains. Although these were considered to be intramolecular in general, the local environment of the polymer molecule exerts a strong influence through, for example, the effects of crystallinity, polarity and diluents. The manner of specimen preparation and previous history also affect transitions. The transitions are considered to arise when sufficient free volume is available to permit the occurrence of these side chain and backbone reorientations. The glass transition is the principal transition of amorphous polymeric materials and is associated with the onset of long range segmental motion of the polymer backbone. The various types of shorter range motion occurring below the glass transition have been catalogued. Author

N76-17248*# Corning Glass Works, N.Y.
DIMENSIONAL STABILITY Technical Report, Jun. 1972 - Oct. 1975
Robert Hochen and Ben Justie Feb. 1976 49 p refs
(Contract NAS8-28662)
(NASA-CR-144162) Avail: NTIS HC $4.00 CSCL 11D

The temporal stability of glass and glass-ceramic materials is important to the success of a large diffraction-limited telescope. The results are presented of an experimental study of the dimensional stability of glasses and glass ceramics being considered for substrates of massive diffraction-limited mirrors designed for several years of service in earth orbit. The purpose of the study was to measure the relative change in length of the candidate substrate materials, to the order of 5 parts in 10 to the 8th power, as a function of several years time. The development of monolithic test etalons, the development and improvement of two types of ultra-high precision interferometers, and certain aspects of tests data presently achieved are discussed. Author

N76-17249*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FILM THICKNESS MEASUREMENTS ON FIVE FLUID FORMULATIONS BY THE MERCURY SQUEEZE FILM CAPACITANCE TECHNIQUE
William R. Jones, Jr., Robert L. Johnson, I. Hyslop, and R. Day Washington Feb. 1976 22 p refs
(NASA-TN-D-8171; E-8554) Avail: NTIS HC $3.50 CSCL 11H

The thinning characteristics of five fluids were studied by measuring film thickness as a function of time. The mercury squeeze film capacitance technique was used. All tests were performed at room temperature. The synthetic hydrocarbon plus a nematic liquid crystal, N-(p-methoxybenzylidene)-p-butylaniline, thinned according to a Newtonian model and retained its bulk viscosity. The synthetic hydrocarbon plus a phosphonate antiwear additive and the synthetic hydrocarbon plus n-hexadecanol produced residual thick films. The synthetic hydrocarbon base fluids and the synthetic hydrocarbon plus a paraffinic resin displayed viscosity increases during thinning, but no residual films were formed. Author

N76-17250*# Bureau of Mines, Minneapolis, Minn. Mining Research Center.
SURFACE FRICTION OF ROCK IN TERRESTRIAL AND SIMULATED LUNAR ENVIRONMENTS
Wallace W. Roepke and Syd S. Peng Apr. 1975 35 p refs
(NASA Order R-09-040-001)
(NASA-CR-146359) Avail: NTIS HC $4.00 CSCL 11G

The conventional probe-on-the rotating-disk concept was used to determine the surface friction in mineral probe/specimen interfaces. Nine rocks or minerals and two stainless steels were tested in both new (NT) and same track (ST) tests under three different pressure environments-atmospheric, UHV, and dry nitrogen. Each environment was further subdivided into two testing conditions, that is, ambient and elevated (135 C) temperatures. In NT tests, friction was the lowest in an atmospheric pressure condition for all rock types and increased to the largest in UHV ambient condition except for pyroxene and stainless steel. Friction values measured in dry nitrogen ambient condition lie between the two extremes. Heating tends to increase friction in atmospheric and dry nitrogen environment but decreases in UHV environment with the exception of stainless steel, basalt, and pyroxene. In ST tests, friction was the lowest in the first run and increased in subsequent runs except for stainless steel where the reverse was true. The increases leveled off after a few runs ranging from the second to the seventh depending on rock types. Author

N76-17251# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
POTENTIAL OF SPUTTERED FILMS AS PROTECTIVE COATINGS
K. Gentner 21 May 1975 48 p refs
(ZR02206)
(AD-A015037; NADC-75038-30) Avail: NTIS CSCL 11/3

One to ten micron thick films of novel and refractory materials, deposited by means of sputtering techniques, have demonstrated outstanding protective characteristics when tested under severe thermal shock conditions at high temperatures, or in accelerated dynamic erosion tests of T-58 first stage compressor blades. Author (GRA)

N76-17252# Monsanto Research Corp., St. Louis, Mo.
DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR BULK OIL TEMPERATURES OF MINUS 40 TO 465 DEG F Final Report, 1 Apr. 1973 - 31 Jul. 1974
F. S. Clark, D. R. Miller, and S. L. Reid Apr. 1975 61 p refs
(Contract F33615-73-C-5079; AF Proj. 7343)
(AD-A014808; MRC-SL-477; AFML-TR-74-247) Avail: NTIS CSCL 11/8

Reformulation of a developmental MIL-L-27502 ester lubricant - MCS 1034A - undertaken to produce an improved oil of greater oxidation resistance and longer shelf life. Two new formulations resulted: (a) An oil with oxidative stability similar to the reference ester at 428F, but with improved stability at 464F. After 72 hours at 464F the viscosity increase of the new fluid is only one-half that of the reference--the acid number is about one-third that of the reference; and (b) An oil with oxidative properties comparable to the reference ester but with improved storage life. Five gallons of fluid (a) were blended and forwarded to WPAFB for further evaluation. GRA

N76-17253# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy and Metals Science.
IMPROVED REFRACTORY OXIDES FOR STRUCTURAL APPLICATIONS Final Technical Report
A. H. Heuer Aug. 1975 14 p refs
(Contract N00014-67-A-0404-0003; NR Proj. 032-508)
(AD-A014973) Avail: NTIS CSCL 11/2

This research is concerned with Al2O3, and ZrO2. An important feature of the research was the extensive use of transmission electron microscopy to fully delineate the mechanical property: deformation substructure relationship. GRA

N76-17254# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
VOLATILITY CHARACTERISTICS OF MIL-L-7808 TURBINE LUBRICANTS Technical Report, Sep. 1972 - Sep. 1974
H. A. Smith and P. W. Centers Jun. 1975 39 p refs
(AF Proj. 3048)
(AD-A015034; AFAPL-TR-75-17) Avail: NTIS CSCL 11/8

An investigation of MIL-L-7808 lubricant volatility was conducted using ASTM Test Methods D972 and D2878 and by using thermogravimetric analysis. This investigation was conducted to: (1) investigate wide variations in manufacturer's reported batch-to-batch evaporation values which were not supported by gas chromatography, (2) determine evaporation and vapor pressure values of current MIL-L-7808 qualified lubricants using ASTM Test Methods D972 and D2878 and, (3) determine the value of using thermogravimetric analysis for measuring lubricant volatility. Individual esters, lubricant basestocks and formulated lubricants of known composition were investigated under varying parameters of temperature, gas flow rates and test times. Calibration procedures and check-out of equipment is described. This investigation has shown that batch-to-batch variation in lubricant volatility does not exist to the extent reported by batch-to-batch quality control testing and that ASTM Method D972 is satisfactory for measuring MIL-L-7808 lubricant evaporation characteristics. Recommendations are given which will enable each laboratory to evaluate test equipment and technique. This investigation has also shown that thermogravimetric analyses does not possess any advantages over ASTM Methods D972 and D2878 for measuring MIL-L-7808 lubricant volatility characteristics. Author (GRA)

N76-17255# State Univ. of New York, Syracuse. Coll. of Environmental Science and Forestry.
MODEL POLYMERS FOR BLACK ORLON WITH ANTHYRIDINE AND PENTHYRIDINE UNITS Final Report, 1 Oct. 1971 - 31 Mar. 1975
Paul Caluwe and M. Szwarc 15 Aug. 1975 53 p refs
(Grants DA-ARO(D)-31-124-72-G24;
DA-ARO(D)-124-72-G109)
(AD-A015199; ARO-10244.2-C) Avail: NTIS CSCL 07/3

The high thermal stability of 'black orlon'--composed of a linearly annelated sequence of partially oxygenated 1,8-naphthyridine units--prompted the authors to investigate the synthesis of well-characterized model systems for this material. The introduction of the anthyridine or 1,8-naphthyridine heterocyclic systems in fully aromatic polymers would provide model polymers for pyrolyzed poly (acrylonitrile). The research described in this report details a new and extremely versatile reaction sequence leading to the 1,8-naphthyridine system that can be adapted to polymer synthesis in linear as well as ladder systems. Ring formation or annelation is achieved via the Friedlander condensation of compounds containing the o-amino aldehyde functional groups and ketomethylenes. The key step in this new approach to monomer synthesis is the base-catalyzed condensation of 4-aminopyrimidine-5-carboxaldehyde (readily available from malononitrile and formamidine acetate) and ketones, followed by acid hydrolysis of the intermediate pyrido (2,3-d) pyrimidine systems resulting in the formation of compounds containing a new o-amino aldehyde functional group. GRA

N76-17256# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Macromolecular Science.
THE PRESSURE AND TEMPERATURE EFFECTS ON BRITTLE TO DUCTILE TRANSITION IN PS AND PMMA
K. Matsushige, S. V. Radcliffe, and E. Baer 5 Sep. 1975 38 p refs
(Contract N00014-75-C-0795)
(AD-A015237; TR-275) Avail: NTIS CSCL 11/9

Tensile experiments in polystyrene (PS) and polymethyl methacrylate (PMMA) conducted at constant strain rate over a wide range of pressure and temperature have shown that a

brittle to ductile transition is induced in these amorphous polymers by the superposition of hydrostatic pressure as well as by the raise of the experimental temperature. A detailed stress-strain analysis permits explanation of the mechanism for the brittle to ductile transition in terms of interaction between two competing processes of plastic yielding -- crazing and shear banding phenomena. The crazing and shear banding processes respond quite differently to changes of pressure or temperature. The evidence that the brittle to ductile transition pressure becomes lower with increasing temperature refutes a previously suggested concept that the transition relates primarily to mechanical relaxation phenomena. GRA

N76-17257# General Electric Co., Schenectady, N.Y.
IMPACT RESPONSE CHARACTERISTICS OF POLYMERIC MATRICES Final Report, 12 Feb. 1974 - 11 May 1975
William B. Hillig Aug. 1975 86 p refs
(Contract N00019-74-C-0147)
(AD-A015131; SRD-75-083) Avail: NTIS CSCL 11/9

Impact/indentation velocity measurements on polycarbonate (PC) and polymethylmethacrylate (PMMA) have been measured to 6000 inches/minute using a 4.5 mm diameter ball as the impacting object. The 'best' force versus penetration depth values are given covering the range .0002 inches/minute to the maximum. Load relaxation measurements are reported and are found to have a characteristic time-decay constant inversely proportional to the impact velocity. This anomalous result causes a sensitive time dependence to be obscured under ordinary conditions. The deformation zone is found to consist of densified material and appears to result from an anelastic yielding. Models, analyses, and interpretations of the results are developed. The phenomena are believed to be fairly broadly applicable to other polymers. GRA

N76-17258# Naval Surface Weapons Center, White Oak, Md.
EVALUATION OF ADHESIVES FOR USE IN THE HI FRAG 5 INCH/54 PROJECTILE Final Report
Anthony L. Rowek 22 Jan. 1975 27 p refs
(AD-A006669; NSWC/WOL/TR-75-6) Avail: NTIS CSCL 11/1

The adhesive bonding characteristics of four polymeric materials: untreated cross-linked polyethylene, surface flame treated cross-linked polyethylene, nylon 12 and ethyl cellulose; with two adhesives, epoxy and urethane, and PBXN-106 were evaluated in light of their potential use in the 5 in/54 high fragmentation (Hi-Frag) projectile. The failure mechanisms of each of these systems and the effect of thermal aging on the fabricated adhesive joints are discussed. Recommendations are made concerning the choice of optimal beaker and adhesive materials for use in the Hi-Frag projectile. Author (GRA)

N76-17259# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Mechanical Engineering.
RECOMMENDATIONS FOR THE MILITARY SPECIFICATION: PLASTIC FILM, POLYETHYLENE FOR BALLOON USE Scientific Interim Report
Harold Alexander and Purushottam Agrawal Apr. 1975 60 p refs
(Contract F19628-72-C-0100; AF Proj. 6665)
(AD-A014865; ME-RT-75005; AFCRL-TR-75-0309; SR-3) Avail: NTIS CSCL 11/9

A program to establish testing methods for use in military specifications for polyethylene balloon film is reported. Previously determined methods are reviewed along with early versions of the military specification. The presently reported program includes (1) the specification of grips for uniaxial testing, (2) uniaxial sample preparation, (3) ultimate property determining in uniaxial testing, (4) crease and seal testing, (5) resin characterization for assurance of consistency between batches, and (6) cold brittleness determination. Recommendations for changes are made in each of these categories. Author (GRA)

N76-17260# Army Materials and Mechanics Research Center, Watertown, Mass.
INTER- AND INTRA-MOLECULAR FORCES IN POLYMERS: A SUMMARY OF A SYMPOSIUM Final Report
Michael N. Alexander Jul. 1975 15 p refs
(DA Proj. 1T1-61102-B-32A)
(AD-A015478; AMMRC-MS-75-5) Avail: NTIS CSCL 07/4

Summaries are given of papers presented at the Symposium on Inter- and Intra-Molecular Forces, sponsored by AMMRC and MIT, and held 6-7 January 1975. Round table discussions are also summarized. A short bibliography is included. GRA

N76-17261# California Univ., Berkeley. Dept. of Chemical Engineering.
GRADIENT POLYMERS BY DIFFUSION POLYMERIZATION
G. Akovali, K. Biliyar, and M. Shen 1 Sep. 1975 25 p refs
(Contract N00014-75-C-0955)
(AD-A015323; TR-3) Avail: NTIS CSCL 07/3

Gradient polymers are multicomponent polymers whose structures or compositions are not macroscopically homogeneous, but vary as a function of position in the sample. One method to prepare such polymers is by diffusing a guest monomer into a host polymer, and then polymerizing the monomer in position to retain the concentration gradient created by the diffusion. One series of such type of materials were prepared by diffusing acrylonitrile into polystyrene. These gradient polymers exhibit improved resistance to hydrocarbon solvents. The second series of gradient polymers were made by diffusion of methyl acrylate into poly (methyl methacrylate). These materials are shown to possess substantially increased fracture strain. Eyring's stress-biased activated rate theory of yielding was used to rationalize the observed toughening effect in gradient polymers. GRA

N76-17262# Army Construction Engineering Research Lab., Champaign, Ill.
ISOTROPIC-KINEMATIC HARDENING MODEL FOR ELASTIC-PLASTIC CYCLIC STRUCTURAL ANALYSIS Final Report
John F. McNamara and Sushilk Sharma Aug. 1975 20 p refs
(DA Proj. 4A1-61102-AT-23)
(AD-A014945; CERL-TR-M-148) Avail: NTIS CSCL 13/8

This report outlines the use of a combined isotropic-kinematic hardening theory to analyze structures undergoing large reversals of plastic strain. The numerical work is based on the finite element method, and a suitable incremental stress-strain relation of combined hardening theory of plasticity is implemented; the theory requires only minor additions to the more common kinematic or isotropic hardening rules. The report shows the required parameters describing the kinematic and isotropic portions of the combined hardening theory can be extracted from cyclic mechanical tests. The theory is used to determine the cyclic response of a mild steel beam. The uniaxial arbitrary cyclic behavior of mild steel is very accurately modeled by a series of spring-slider elements. Author (GRA)

N76-17263# Materials Research Lab., Inc., Glenwood, Ill.
FRACTURING CHARACTERISTICS OF ADHESIVE JOINTS Final Report, 31 Jan. 1974 - 15 Jan. 1975
Sheldon Mostovoy and E. J. Ripling Sep. 1975 57 p refs
(Contract N00019-74-C-0274)
(AD-A016288) Avail: NTIS CSCL 13/5

In the first section, the dependence of crack velocity on crack extension force, G, over a range of G values from approximately 0.5 to 5.0 lb/in. is discussed. In the second section the 300F curing epoxy, MRL-3, is shown to be independent of cyclic frequency over the range from 0.67 to 180 cpm in both laboratory air and liquid water. At room temperature the adhesive is shown to be more resistant to fatigue crack extension in water than in ambient humidity. At elevated temperatures the crack growth rate is much faster than it is at room temperature and the adhesive becomes frequency dependent. Section 3 compares the fracture toughness of a number of adhesives with the fatigue threshold value and the stress corrosion cracking threshold G as a function of testing temperature. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N76-17264# Exxon Research and Engineering Co., Linden, N.J. Government Research Lab.

DEVELOPMENT OF HIGH STABILITY FUEL Midterm Report, 1 Apr. - 31 Jul. 1975

William F. Taylor and John W. Frankenfeld Jul. 1975 84 p refs

(Contract N00140-74-C-0618)

(AD-A016592; GRU.14GAHF.75) Avail: NTIS CSCL 21/4

A study of the effects of interactions between olefins and sulfur, nitrogen and oxygenated compounds in deoxygenated JP-5 has been initiated. This study is designed to determine what compound types can undergo interactions in this system and whether innocuous species may interact to form deleterious reaction products. The first interactions studied were between certain sulfur, nitrogen and oxygen compounds and olefins. These runs are complete. In addition, several runs have been made to investigate the interactions between nitrogen and sulfur containing compounds. GRA

N76-17265# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

ASSESSMENT OF JP-8 AS A REPLACEMENT FUEL FOR THE AIR FORCE STANDARD JET FUEL JP-4. PART 1. ASSESSMENT OF JP-8/JP-4 FUEL IN NONCOMBAT ENVIRONMENT Final Report, Jun. 1972 - Apr. 1975

G. T. Beery, R. G. Clodfelter, G. W. Gandee, D. M. Spear, and D. C. Wight Jun. 1975 91 p refs

(AF Proj. 3048)

(AD-A016763; AFAPL-TR-74-71-Pt-1) Avail: NTIS CSCL 21/4

This report is an assessment of JP-8 as a replacement fuel for the Air Force standard jet fuel JP-4. All facets of the problem are examined including fire safety under combat and noncombat conditions, crash fire safety, storage, handling and maintenance safety, laboratory testing, gunfire testing, flight testing, cost and availability, and impact on current Air Force weapons systems. The report concludes that a significant improvement in overall fire safety could be achieved by conversion to JP-8 however, additional investigation into problems related to low temperature ground start and altitude relight should be accomplished prior to conversion. GRA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N76-17266 Shock and Vibration Information Center (Defense), Washington, D.C.

THE SHOCK AND VIBRATION DIGEST, VOLUME 7, NO. 9, SEPTEMBER 1975

Sep. 1975 112 p refs

(AD-A015660) Avail: Paper copy available from Shock and Vibration Information Center, Naval Research Lab., Code 6020, Washington, D. C. 20390. Annual subscription $40.00

Bibliographical data, abstracts, military research, and periodical information are given on the dynamic response of structures to shock and vibration. For individual titles, see N76-17267 through N76-17268.

N76-17267 Stanford Univ., Calif.

MULTISTEP INTEGRATION METHODS FOR TRANSIENT PROBLEMS c39

M. Geradin *In* Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 7, No. 9 Sep. 1975 p 3-20 refs Presented at the Open Forum of the 1973 Western Appl. Mech. Conf., Menlo Park, Calif. (For availability see N76-17266 08-31)

Various approximation methods were posed to carry out the direct integration in time of the equations of structural dynamics. All these direct integration schemes can be classified as one step and multistep methods depending on whether their memory extends beyond the previous solution. Data here are limited to the latter class of methods, including derivation of the consistency conditions providing a multistep method of given order, evaluation of the load truncation error, and stability and accuracy analyses. Application of these concepts is made to two- and three-step methods: various schemes can be deduced from the general formulas, depending on the value of their free parameters. Author

N76-17268 Southampton Univ. (England). Inst. of Sound and Vibration Research.

NOISE CHARACTERISTICS OF AXIAL AND CENTRIFUGAL FANS AS USED IN INDUSTRY c37

B. D. Mugridge *In* Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 7, No. 9 Sep. 1975 p 93-107 refs (For availability see N76-17266 08-31)

Working guidelines are given for predicting noise generation of axial and centrifugal fans. Techniques discussed include noise reduction by installation design, choosing correct size and type of fan and optimization of operating flow conditions. These steps enable the installation engineer to design for minimum noise generation which is the most effective form of noise reduction. Author

N76-17269# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

ON THE THEORY OF GROUND ANCHORS

Austin Kovacs, Scott Blouin, Bruce McKelvy, and Herman Colligan Jan. 1975 81 p refs

(DA Proj. 1T0-62112-A-130)

(AD-A006582; CRREL-TR-258) Avail: NTIS CSCL 13/13

The findings of a literature review of anchor design are presented to give a synopsis of the numerous theoretical and empirical techniques available for predicting anchor capacity. The review revealed that anchor capacity is related to anchor configuration, soil characteristics, and depth of anchor embedment, and that the mode of soil failure as a result of anchor loading is dependent upon soil type and state as well as on the ratio of the depth of anchor embedment to anchor diameter. It was found that no single equation can be used to predict anchor capacity under all soil conditions or anchor embedment depths. Author

N76-17270# Naval Undersea Center, San Diego, Calif.

DEEP OCEAN LIFT BAG Final Report, Oct. 1973 - Feb. 1975

R. T. Hoffman May 1975 39 p refs

(AD-A015273; NUC-TP-455) Avail: NTIS CSCL 13/10

A lift bag of 10-ton nominal capacity has been fabricated from Kevlar-29 fabric. Laboratory and operational test data are presented together with recommended design changes. The bag weighed 166 pounds in air and required a storage volume of about 15 cubic feet. Ply strength efficiencies of 100% were demonstrated, and maximum working strains encountered during static testing were 3.5%. GRA

N76-17271# Oregon Univ., Eugene. Dept. of Physics.

THE PHYSICS OF FLUIDS AND ITS APPLICATIONS Final Report, 1 Jan. 1971 - 30 Jun. 1975

R. J. Donnelly and Paul H. Roberts 15 Jul. 1975 269 p refs

(Grant AF-AFOSR-1999-71; AF Proj. 9767)

(AD-A015183; AFOSR-75-1370TR) Avail: NTIS CSCL 20/13

Contents: (1) Experimental research on liquid helium (2) Nucleation of quantized vortices in liquid helium (3) Hydrodynamics of liquid helium II (4) Onsager conference rotons as quantized vortices and roton interactions Motions in a Bose condensate (5) The calculated properties of helium II; statistical mechanics of interacting bosons and (7) Infrared detectors and Air pollution research. GRA

N76-17272# Philips Labs., Briarcliff Manor, New York.

DESIGN AND FABRICATION OF A RHOMBIC DRIVE STIRLING CYCLE CRYOGENIC REFRIGERATOR Final Report

Charles Balas, Jr. Apr. 1975 8 p
(Contract DAAK02-72-C-0224)
(AD-A015198; AD-A015197) Avail: NTIS CSCL 13/1

This report summarizes the cooler modifications, operational difficulties, and the resulting cooler performance that occurred since the original cooler delivery on July 2, 1973. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N76-17273 California Univ., Los Angeles.
THE ANALYSIS AND SYNTHESIS OF DIGITAL FILTERS Ph.D. Thesis
Howard Holtz 1975 311 p
Avail: Univ. Microfilms Order No. 76-3042

Digital filters are first defined and classified, and the development of engineering applications of numerical analysis is reviewed. The existing body of knowledge concerning digital filters is organized and selected for presentation to the engineer. Specific problems in digital filtering of interest to the signal-processing engineer are treated. New methods of synthesizing open-loop digital filters are presented. Procedures are derived for the construction of digital filters whose frequency response is uniformly convergent to an ideal frequency response. Windowing techniques are discussed and extended. Procedures for the construction of recursive digital filters which are optimal in the minimax sense are demonstrated. The Remes algorithm is extended to obtain stable recursive filters. Dissert. Abstr.

N76-17274 Virginia Polytechnic Inst. and State Univ., Blacksburg.
WIDEBAND ROTARY TRANSFORMER FOR VHF USE Ph.D. Thesis
Charles W. Allen 1976 88 p
Avail: Univ. Microfilms Order No. 76-3847

A device which transmits wideband VHF signals across a rotating structure is described. It has potential application to antenna systems which rotate and also to telemetry between stationary and rotating structures. No electrical contact is necessary between stationary and rotating terminals. The bandwidth typically is 1000:1 and the device can be designed to operate from a few megahertz to well up into the VHF band. A successful prototype was developed which verifies the device theory. Dissert. Abstr.

N76-17275 Ohio State Univ., Columbus.
DEGRADATION DUE TO QUANTIZATION EFFECTS IN DIGITAL LOW-PASS FILTERS Ph.D. Thesis
Larry John Fruit 1975 202 p
Avail: Univ. Microfilms Order No. 76-3431

The basic idea of the degradation factor and its usefulness to the designer was developed. Techniques for deriving discrete transfer functions from given continuous transfer functions are discussed and criteria for simplifying the definition of the degradation factor are presented. Noise models are introduced in order to demonstrate techniques to simplify the evaluation of the degradation factor for parallel and cascade digital filter realizations using first and second order sections. The noise models are also used to analyze the quantization effects of the analog-to-digital conversion and arithmetic round-off. A computer program for the evaluation of the degradation factor and frequency response of specific digital filters is presented. Steps for the use of the degradation factor in practical applications are presented and one practical design example is discussed. Dissert. Abstr.

N76-17276 Nebraska Univ., Lincoln.
WAVE PROPAGATION IN INHOMOGENEOUS NONUNIFORM STRUCTURES
Gopalan Govindarajan 1975 217 p
Avail: Univ. Microfilms Order No. 76-4519

Four different problems of electromagnetic wave propagation in inhomogeneous nonuniform structures are investigated. The scattered fields for a line source located above nonuniform stratified earth are computed on the basis of a full wave analysis which accounts for both uniform plane wave and surface wave excitations. The relationships between the full wave and the geometrical optical solutions are discussed. The full wave solutions are shown to satisfy the reciprocity relationships in electromagnetic theory. The differences between the radiation patterns generated by an input surface wave and an input plane wave at grazing incidence are brought out. The dependence of the radiation patterns on the various electrical and geometrical parameters of the earth is discussed in detail. Dissert. Abstr.

N76-17277*# Dynamic Development Co., Escondido, Calif.
STUDY TO INVESTIGATE AND EVALUATE MEANS OF OPTIMIZING THE RADAR FUNCTION FOR THE SPACE SHUTTLE Final Report, 16 May - 15 Dec. 1975
23 Dec. 1975 315 p
(Contract NAS9-14615)
(NASA-CR-147426; Rept-6) Avail: NTIS HC $9.75 CSCL 17I

Results are discussed of a study to define a radar and antenna system which best suits the space shuttle rendezvous requirements. Topics considered include antenna characteristics and antenna size tradeoffs, fundamental sources of measurement errors inherent in the target itself, backscattering crosssection models of the target and three basic candidate radar types. Antennas up to 1.5 meters in diameter are within specified installation constraints, however, a 1 meter diameter paraboloid and a folding, four slot backfeed on a two gimbal mount implemented for a spiral acquisition scan is recommended. The candidate radar types discussed are: (1) noncoherent pulse radar (2) coherent pulse radar and (3) pulse Doppler radar with linear FM ranging. The radar type recommended is a pulse Doppler with linear FM ranging. Block diagrams of each radar system are shown. Author

N76-17278*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ATS-6 SPACECRAFT: IN-FLIGHT ANTENNA PATTERN MEASUREMENT
L. W. Nicholson, H. Hanft, B. G. Bemis, and R. L. Baldridge
Washington Jan. 1976 145 p ref
(NASA-TN-D-8135; G-7614) Avail: NTIS HC $6.00 CSCL 17B

Antenna patterns, principally associated with the 9.1 meter parabolic antenna of the ATS-6 spacecraft, were measured while in orbit at quasi-stationary synchronous altitude. Controlling the spacecraft attitude permitted a scanning of the spacecraft antenna pattern over the Rosman ground station, thus achieving the measurement of the antenna pattern contour. Patterns were determined in terms of relative gain referenced in position to the spacecraft body coordinates by means of signal power measurements made using a linear detector. These data were subsequently correlated with the attitude data to define the antenna patterns. Antenna patterns measured are presented and compared with available preflight patterns. Author

N76-17279# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
ANTENNA DEVELOPMENTS FOR AEROSPACE RESEARCH VEHICLES Scientific Interim Report
Raymond E. Wilton 30 Apr. 1975 44 p refs
(AF Proj. 7659)
(AD-A014778; AFCRL-TR-75-0239; AFCRL-IP-232) Avail: NTIS CSCL 09/5

Concurrently with other instrumentation efforts, studies have been conducted leading to the development of antenna systems to be used on aerospace research vehicles. The report describes primarily those antennas developed for UHF telemetry applications that are used with instrumented research rocket payloads. Other antennas associated with tracking systems are also included. Several unique design techniques are described that have resulted in significant electrical and aerodynamic improvements. GRA

N76-17280# Syracuse Univ., N.Y.
A LOW-FREQUENCY EXPANSION FOR CHARACTERISTIC MODES OF CONDUCTING BODIES
Harvey K. Schuman and Roger F. Harrington Aug. 1975 98 p

refs
(Contract N00014-67-A-0378-0006; NR Proj. 371-885)
(AD-A015297; TR-75-7; TR-3) Avail: NTIS CSCL 20/14

A lossless, electrically small body of an arbitrary shape has an associated set of characteristic current distributions. Upon excitation only a few of these currents are the major contributors to the radiation field. Since their inception less than a decade ago, characteristic-mode theory and application have been investigated primarily in the resonance region. The purpose of the report is to extend this investigation to low frequencies. GRA

N76-17281# Ohio State Univ., Columbus. ElectroScience Lab.
ADAPTIVE ARRAY BANDWIDTH WITH TAPPED DELAY-LINE PROCESSING Final Quarterly Report
W. E. Rodgers and R. T. Compton, Jr. May 1975 72 p refs
(Contract N00019-74-C-0141)
(AD-A015098; ESL-3832-3) Avail: NTIS CSCL 09/5

The report discusses tapped delay-line processing in adaptive arrays. Such processing is being considered as a method for improving the bandwidth of adaptive arrays. The SNR performance of a two-element array with four types of processing (quadrature hybrids, single quarter wavelength delay-lines, 3-tap delay lines and 5-tap delay lines) is compared. It is shown that for two elements a half wavelength apart, a quadrature hybrid processor and a single quarter wavelength delay-line processor are inadequate at 10% bandwidth. A 3-tap processor is adequate, however, up to 40% bandwidth. GRA

N76-17282# Naval Postgraduate School, Monterey, Calif.
A FLEXIBLE SPREAD SPECTRUM SYSTEM M.S. Thesis
Sidney Minard Skjei, Jr. Jun. 1975 111 p refs
(AD-A014718) Avail: NTIS CSCL 14/2

A discussion of the design, and construction and use of a Pseudo-Noise Sequence Generator/Correlator and a Flexible Spread Spectrum System in which it is employed is presented. This equipment is an educational tool for instruction, research and demonstration of spread spectrum techniques. Pseudo-Noise sequences of lengths 7 through 4095 are generated and used to spread a signal over a maximum bandwidth of approximately 15 MHz. Signals spread over a bandwidth of 5 MHz or less may be successfully recovered by means of a Delay-Lock Tracking Loop. Linear and hardlimited channel configurations are available. Message bandwidths up to approximately 28 kHz are accommodated. While designed as an educational tool, the Flexible Spread Spectrum System has a stand-alone capability as a cable communications system. GRA

N76-17283# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SPEECH UNDERSTANDING SYSTEMS Quarterly Technical Progress Report, 1 Nov. 1974 - 1 Feb. 1975
William A. Woods, Richard M. Schwartz, John W. Klovstad, Craig C. Cook, Jared J. Wolf, Madeleine A. Bates, Bonnie L. Nash-Webber, Bertram C. Bruce, and Victor W. Zue Mar. 1975 77 p refs
(Contract N00014-75-C-0533; ARPA Order 29)
(AD-A007586; BBN-3018; AI-24; QTPR-1) Avail: NTIS CSCL 05/7

Acoustic-phonetics, lexical retrieval, lexical verification, and natural language syntax, semantics and pragmatics are included. The report consists of two parts -- a brief Survey of Progress containing a few paragraphs describing the major progress in the individual components of the project, and a Technical Notes section containing detailed specifications of experiments performed, programs implemented, design studies, and, where appropriate, supporting data and appendices. GRA

N76-17284# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
WIDEBAND SOLID-STATE PHASED-ARRAY ANTENNA DEVELOPMENT AT UHF
G. J. Laughlin Jul. 1975 101 p refs
(Contract N00017-72-C-4401)
(AD-A015090; APL/JHU/TG-1278) Avail: NTIS CSCL 09/5

Development of an experimental 16-element solid-state linear phased-array antenna that has an operating band from 0.6 to 0.95 GHz is described. Radiating elements in the antenna are novel strip radiators made using printed circuit techniques. The array aperture has been impedance matched to a VSWR-3.0:1 over the octave band from 0.5 to 1.0 GHz with beam scanning to plus or minus 60 degrees in the H plane. Element patterns measured on a 10- by 10-element array aperture indicate that the aperture is also matched with beam scanning to plus or minus 60 degrees in the E plane. Each of the radiators in the 16-element linear array was integrated with a microwave transistor amplifier with a nominal gain of 10 dB and efficiency of 50% at 3 watts output. Bandwidths of the amplifiers limit the 16-element solid-state array to an operating band from 0.6 to 0.95 GHz. Beam scanning in the H plane is accomplished by inserting lengths of coaxial delay lines between the integrated array and a 16:1 power divider network. Techniques and methods used in this development are applicable at higher radar frequencies. GRA

N76-17285# Naval Postgraduate School, Monterey, Calif.
RESONANCE OF ELECTROMAGNETIC WAVES ON CROSS-MONOPOLE WIRE STRUCTURES M.S. Thesis
Robert Cornelius Spencer Jun. 1975 125 p refs
(AD-A015456) Avail: NTIS CSCL 09/5

The investigation experimentally determines the input impedance characteristics of cylindrical monopole and cross-monopole antenna structures of various lengths at 2-12 GHz frequencies. The analyses of the wire structures include a physical reasoning of resonance effects contributed by various members of the cross-monopoles. GRA

N76-17286# Naval Postgraduate School, Monterey, Calif.
A SYSTEMS ANALYSIS OF THE NAVAL ENVIRONMENTAL DATA NETWORK (NEDN) M.S. Thesis
Stuart Anderson Merriken Sep. 1975 75 p refs
(AD-A016339) Avail: NTIS CSCL 17/2

The thesis is a study of the Naval Environmental Data Network (NEDN). The objective of the thesis is to conduct a system analysis of the NEDN to establish a basis for designing or redesigning a better, more cost effective network. Emphasis is placed on communication costs. The study is in two parts. The first part describes the existing system, the Naval Intelligence Data Network(NIDN) which affects the NEDN, the proposed NEDN/NIDN communication terminal, and other networks which are used for comparative purposes. The second part analyzes the NEDN to establish ways to improve the system. The overall conclusion is that cost effective improvements can be made, in particular, reduction of line communication costs. Specific recommendations for improvements are offered. GRA

N76-17287# Lincoln Lab., Mass. Inst. of Tech., Lexington.
EXPERIMENTAL VERIFICATION OF THE PERFORMANCE OF THE APERTURE SAMPLING TECHNIQUE
Israel Kupiec 15 Sep. 1975 46 p refs
(Contract F19628-76-C-0002; DA Proj. 8X3-63304-D-215)
(AD-A016779; TN-1975-45; ESD-TR-75-261) Avail: NTIS CSCL 17/9

An experimental verification of the aperture sampling technique as a means of estimating the angle-of-arrival in the presence of ground reflection interference is reported. The technique is found to perform satisfactorily down to 1/5 of a beamwidth elevation. Beam splitting better than 20:1 is demonstrated. This performance is obtained by using a minimizing search processing that allows use of a larger number of samples than the number required by the closed form solution. GRA

N76-17288# Air Force Communications Service, Richards-Gebaur AFB, Mo.
TRACALS EVALUATION REPORT. PRECISION APPROACH RADAR STATION EVALUATION REPORT, FAIRCHILD AFB, WA
Robert L. Cranston 15 Sep. 1975 46 p
(AD-A016768; Rept-75/66R-46) Avail: NTIS CSCL 17/7

A Precision Approach Radar (PAR) station evaluation was conducted at Fairchild AFB, WA (2039 CS) from 1 Aug. to 8 Aug. 75. This report presents the results of equipment checks, clutter analysis, runway survey, and the flight evaluation. Emphasized in this report is the excessive Angle Voltage Generator (AVG) 24-hour drift which has been observed at 10 of the 11 stateside facilities. In addition, the MTI speed related target

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deterioration which accurred between 164 and 179 knots is discussed. GRA

N76-17289# Technology Service Corp., Santa Monica, Calif.
DETECTION OF WANDERING SIGNALS WITH AN ALI PROCESSOR. PART 1: OVER-RESOLUTION CASE Interim Report, 1 Nov. 1974 - 1 Jul. 1975
Gene B. Goldstein 10 Jul. 1975 65 p refs
(Contract N00014-75-C-0728)
(AD-A016617; TSC-PD-A142-4-Pt-1) Avail: NTIS CSCL 09/4

The detection performance of a specific suboptimum processor, termed the Automatic Line Integrator (ALI), is examined when the signal consists of a sine wave of unknown phase whose frequency wanders within some a-priori band which is searched by the ALI processor. The signal's phase and frequency are considered to be nearly constant for a duration T sub C (termed the 'coherence length') which is unknown to the processor. In this (Part I) study, the detection performance is examined when the ALI processor employs filters which integrate for a time period which is longer than T sub C. General formulas are derived which permit performance calculations to be made as a function of signal and processor parameters. A specific example is presented illustrating the use of the formulas. For the example displayed the ALI processor incurs approximately 4 dB loss relative to the ideal detector which is presumed to have knowledge of the signal's frequency and coherence length. A sequel, Part II, considers the under-resolution regime in which the ALI filter-bank integrates for a time less than T sub C. Author (GRA)

N76-17290# Technology Service Corp., Santa Monica, Calif.
DETECTION OF WANDERING SIGNALS WITH AN ALI PROCESSOR. PART 2: UNDER-RESOLUTION CASE Interim Report, 1 Nov. 1974 - 1 Jul. 1975
Gene B. Goldstein 18 Jul. 1975 27 p refs
(Contract N00014-75-C-0728)
(AD-A016618; TSC-PD-A142-4-Pt-2) Avail: NTIS CSCL 09/4

The detection performance analysis for the ALI processor described in Part I is extended to the under-resolution regime in which the filters integrate for a time shorter than (or equal to) the signal coherence length. Formulas are presented which permit quantitative evaluation of the ALI's under-resolution performance. It is shown that for a fixed processor search band, B (the frequency region where one expects to find the signal if it is present at all), and for a specified signal coherence length and total processing time, the ALI's detection performance is insensitive to the degree of under-resolution committed by the processor. For the specific signal and processor parameters chosen for the Part I example, the ALI's under-resolution loss is smaller than its over-resolution loss over the useful range of detection probability. The under-resolution loss is approximately 2 db relative to the ideal detector which is presumed to have knowledge of the signal's frequency and coherence length. The analysis and performance equations permit a comparison to be made between the overall performance of the suboptimum ALI processor and that which is attainable by the optimum processor. This performance comparison is the subject of a subsequent report.
Author (GRA)

N76-17291# Naval Research Lab., Washington, D.C.
AN INTEGRAL EQUATION METHOD FOR ELECTROMAGNETIC SCATTERING PROBLEMS Interim report
Arthur K. Jordan Oct. 1975 56 p refs
(AD-A016583; NRL-MR-3147) Avail: NTIS CSCL 20/14

The purpose of this memorandum report is to document the analysis which was performed to obtain the matrix equation which represents the electromagnetic fields scattered from axially symmetric targets. Although these results are not new, the analysis is presented in a concise, logical manner which is suitable for computer programming and which provides the foundation for the solution of diverse transient electromagnetic scattering problems by the newer methods of natural mode representations and singularity expansion techniques. The motivation for this study was to formulate in an understandable manner the necessarily complicated and tedious electromagnetic scattering calculations. Even relatively simple targets, e.g., missiles and torpedoes, require lengthy calculations. The integral equation for electromagnetic scattering from axially symmetric targets is derived. The boundary conditions for the case of metallic (perfectly conducting) and for the case of lossy dielectric targets are applied. The integral equation is reduced to matrix form by application of the method of moments. The scattering cross section is derived. A typical target geometry (sphere-cone-sphere) is used as an example. The detailed calculations are documented for reference with future computer calculations. GRA

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N76-17292 Virginia Polytechnic Inst. and State Univ., Blacksburg.
A MODEL OF SATURATED SYNCHRONOUS MACHINES FOR DYNAMIC ANALYSIS AND CONTROL PURPOSES Ph.D. Thesis
Vijay K. Garg 1975 131 p
Avail: Univ. Microfilms Order No. 76-3855

A synchronous machine model in state space form, which is suitable for dynamic analysis of power systems, is developed. The expressions for machine inductances are derived in terms of basic design particulars and magnetic characteristics of the machine. Thus, saturation effect on the machine inductances is accounted for instant by instant during the transients. Furthermore, a technique for discrete time simulation and analysis of saturated synchronous machines under three phase short circuit conditions is presented. A comparison is provided between the data obtained from the developed algorithm, Concordia's method, and laboratory tests on a 3 phase, 5 KVA, VPI and SU, laboratory machine. Conclusions and recommendations are given. Dissert. Abstr.

N76-17293 Virginia Polytechnic Inst. and State Univ., Blacksburg.
QUADRATIC PROGRAMMING FOR OPTIMAL ACTIVE AND REACTIVE POWER DISPATCH USING SPECIAL TECHNIQUES FOR REDUCING STORAGE REQUIREMENTS Ph.D. Thesis
Gyaneshwar Dayal 1975 117 p
Avail: Univ. Microfilms Order No. 76-2090

The difficulty of excessive storage requirements was studied using the quadratic programming approach for solving large size economic dispatch problems. A computer code was developed which implements efficient procedures and techniques developed to suit the power system problems. A method for updating the triangular factors at each iteration of the simplex method is used along with an inversion technique. The code is designed to handle the bounded and free type variables thus reducing the size of the basis matrix. Detailed logic for the pivot row selection was developed so that a feasible solution of the algorithm can be found, while meeting the main aims of the composite simplex algorithm and considering the general type of variables. The computer code was tested for solving the economic dispatch problem taking the IEEE standard test systems up to 118 buses. Results show that the code becomes more effective as the problem size increases. Dissert. Abstr.

N76-17294 Tennessee Univ., Knoxville.
THE DESIGN OF A 4-MEGAWATT INDUCTION HEATING POWER SUPPLY Ph.D. Thesis
James William Cunningham 1975 168 p
Avail: Univ. Microfilms Order No. 76-1935

A description is given of the design of a large vacuum tube oscillator. The oscillator, which was intended as a power source for experiments in induction heating of gasses, utilizes eight triode vacuum tubes in a push-pull parallel configuration, and is capable of an output of 3.2 megawatts at frequencies between 10 and 50 kHz. The design covered three areas: through design of oscillator components to eliminate circuit difficulties which require changes in values of major components, development of an algorithm to map power handling capacity of the tank capacitor

as a function of frequency and load Q, and development of a digital computer program to simulate oscillator operation. The program offers advantages over the classical design technique in that it can be used to study stability and transient response as well as the steady state. The actual operation of the oscillator is compared whenever possible with the predictions of the simulator program. It is found that the load line of the oscillator is a figure eight. This shape, which was predicted by the simulator program, is caused by effects which the classical design technique must neglect. Dissert. Abstr.

N76-17295 Pennsylvania Univ., Philadelphia.
GEOMETRIC EFFECTS ON THE GATE CONTROLLED CAPACITOR Ph.D. Thesis
Elliot Barry Slutsky 1974 186 p
Avail: Univ. Microfilms Order No. 76-3239

Theoretical and experimental determination of the effect of p-n junction geometry on the gate voltage dependent equivalent parallel capacitance (Cp-VG), equivalent parallel conductance (Gp-VG), and quality factor (Q-Vg) characteristics of a gate controlled capacitor (GCC) is discussed. The Q is defined as proportional to the product of the measurement frequency, f, in MHz and Cp in pF divided by Gp. The GCC models were fabricated using standard MIS techniques. Three p-n junction geometries were studied, consisting of a circular and two cross structures. A distributed model is used to describe the influence of the circular p-n junction on the gate-to-diffused region admittance, Yin. The distributed model accuracy predicts the effects of frequency and VG actually obtained by measurements of the experimental circular diffused models. Theoretically modeling the two cross structures was found difficult because of the three dimensionality of the structures. Dissert. Abstr.

N76-17296+ SILEC-Semiconducteurs S.A., Villejuif (France).
CONTACTS FOR POWER DEVICES: USE OF MOLYBDENUM DEPOSITED BY ION BOMBARDMENT FOR THE FIRST LAYER Final Report [REALISATION ET ETUDE DE PRISES DE CONTACT POUR DISPOSITIFS DE PUISSANCE: EMPLOI COMME PREMIERE COUCHE DU MOLYBDENE DEPOSE PAR BOMBARDEMENT IONIQUE]
P. Lanaspeze May 1974 110 p refs In FRENCH
(Contract DGRST-72-7-0013)
Avail: NTIS HC $5.50

Two methods for molybdenum sputtering were studied: high frequency spraying from argon plasma and molybdenum layer condensation by ion bombardment from an argon ion gun. A prototype apparatus of the second kind was developed. Voltage intensity curves were studied in a doping range around 10 to the eighteenth power atm/cu cm. An almost ohmic behavior was observed with strongly reduced resistivity. ESA

N76-17297*# M&S Computing, Inc., Huntsville, Ala.
ARTWORK INTERACTIVE DESIGN SYSTEM (AIDS) PROGRAM DESCRIPTION
B. T. Johnson and J. F. Taylor Feb. 1976 95 p
(Contract NAS8-25621)
(NASA-CR-144167; Rept-73-0002-Rev-1) Avail: NTIS HC $5.00 CSCL 09C

An artwork interactive design system is described which provides the microelectronic circuit designer/engineer a tool to perform circuit design, automatic layout modification, standard cell design, and artwork verification at a graphics computer terminal using a graphics tablet at the designer/computer interface. Author

N76-17298*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REFOCUSING PROPERTIES OF PERIODIC MAGNETIC FIELDS
N. Stankiewicz Washington Feb. 1976 20 p refs
(NASA-TN-D-8170; E-8532) Avail: NTIS HC $3.50 CSCL 09A

The use of depressed collectors for the efficient collection of spent beams from linear-beam microwave tubes depends on a refocusing procedure in which the space charge forces and transverse velocity components are reduced. The refocusing properties are evaluated of permanent magnet configurations whose axial fields are approximated by constant plateaus or linearly varying fields. The results provide design criteria and show that the refocusing properties can be determined from the plateau fields alone. Author

N76-17299*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH EFFICIENCY SILICON SOLAR CELL REVIEW
Michael P. Godlewski, ed. Washington Dec. 1975 235 p refs Meeting held at Cleveland, 14-15 Nov. 1974
(NASA-TM-X-3326; E-8425) Avail: NTIS CSCL 10A

An overview is presented of the current research and development efforts to improve the performance of the silicon solar cell. The 24 papers presented reviewed experimental and analytic modeling work which emphasizes the improvment of conversion efficiency and the reduction of manufacturing costs. A summary is given of the round-table discussion, in which the near- and far-term directions of future efficiency improvements were discussed. Author

N76-17300# Brookhaven National Lab., Upton, N.Y.
DIELECTRIC DESIGN CONSIDERATIONS FOR A FLEXIBLE SUPERCONDUCTING POWER TRANSMISSION
E. B. Forsyth, A. J. McNerney, and A. C. Muller 1975 11 p refs Presented at Intern. Cryog. Mater. Conf., Kingston, Ontario, Canada, 22 Jul. 1975 Sponsored by ERDA
(BNL-19839; Conf-750716-4) Avail: NTIS HC $4.00

Examination of the dielectric and mechanical properties of the five tapes evaluated indicates that none simultaneously fulfills all the requirements of superconducting cable design, however, several have excellent properties and are close to meeting these requirements. Polyethylene easily meets the dielectric requirements but was found to possess substandard yield strengths and tensile moduli. Polyamide and polysulfone exhibited acceptable yield strengths but their moduli are probably still too low for satisfactory taping. Also, the dielectric properties of these materials may be slightly outside design specifications. The polycarbonate was found to possess completely acceptable mechanical properties but its loss tangent appears to be much too high. Author (NSA)

N76-17301# Rockwell International Corp., Newport Beach, Calif. Collins Radio Group.
DESIGN AND DEVELOPMENT OF MOS SCALER/LOGIC AND OVERHEAD SAFETY INTEGRATED CIRCUIT Final Report, May 1974 - May 1975
Gerald L. Donaldson and John J. Illgner May 1975 323 p refs
(Contract DAAG39-74-C-0161; DA Proj. 1W6-64602-D-454; HDL Proj. 653460)
(AD-A014944; HDL-CR-75-161-1; Rept-765-5608-001) Avail: NTIS CSCL 09/5

This report presents the results of the design, fabrication and test effort of a MOS/LSI Integrated Circuit used in the XM587E2/XM724 Electronic Time Fuze designed by Harry Diamond Laboratories. The integrated circuit designed performs the scaling and overhead safety functions of the fuze system. This device was a modification of HDL part number 10990474, produced under Contract DAAG39-73-C-0050. Included in the modification were the results of a study contract (DAAG39-74-M-1987) affecting the input channel logic of part number 10990474, and the incorporation of the overhead safety circuit of HDL drawing 11711254. The MOS/LSI circuit was successfully designed, manufactured and tested to all requirements of Contract DAAG39-74-C-0161. Two hundred (200) devices packaged in ceramic packages, and 200 devices packaged in molded-plastic packages were subjected to specified qualification tests and then shipped to HDL. Author (GRA)

N76-17302# National Bureau of Standards, Boulder, Colo. Electromagnetics Div.
CHARACTERIZATION OF HIGH FREQUENCY PROBE ASSEMBLY FOR INTEGRATED CIRCUIT MEASUREMENTS Final Report, 10 Jan. - 30 Jun. 1974
R. L. Jesch and C. A. Hoer Aug. 1975 72 p refs Sponsored by AF
(AD-A014833; AFWL-TR-74-345) Avail: NTIS CSCL 09/5

A detailed, applications-oriented description of a measurement technique that characterizes a high-frequency probe assembly for integrated circuit measurements is given along with the

procedure that extracts the parasitic effects of the probe assembly. The scattering parameters of an integrated-circuit device or transistor can now be extracted and accurately determined up to 2 GHz at the wafer stage of assembly. This represents a significant advance over conventional techniques that enabled only dc parameters to be measured. Measurement results using this technique are given along with the precision of values obtained as well as the nature of bias introduced. Author (GRA)

N76-17303# Air Force Academy, Colo. Frank J. Seiler Research Lab.

SEM INVESTIGATION OF IC DEFECTS Final Report

Jerome R. Clifford Jun. 1975 19 p refs

(AF Proj. 7903)

(AD-A014803; FJSRL-TR-0010) Avail: NTIS CSCL 09/5

An investigation of integrated circuit (IC) defects was conducted using the scanning electron microscope (SEM) at the U.S. Air Force Academy. The study included two main areas of interest: thermal effects on Au-Al intermetallic formation and radiation damage to thermocompression bonds. GRA

N76-17304# Arizona Univ., Tucson. Dept. of Chemistry.

CONSIDERATIONS WHEN EMPLOYING STEPPER MOTORS FOR AUTOMATING LABORATORY SYSTEMS

M. B. Denton, M. W. Routh, J. D. Mack, and D. B. Swartz 12 Sep. 1975 26 p refs

(Contract N00014-75-C-0513; NR Proj. 051-549)

(AD-A015367; TR-7) Avail: NTIS CSCL 13/8

Considerations and tradeoffs when employing stepper motors under computer control are discussed. A unique programmable stepper motor controller is described which provides simple, efficient and inexpensive interfacing between the digital domain of the computer and the world of physical rotary motion often required for positioning or adjusting mechanical devices. GRA

N76-17305# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

XENON FLASH LAMPS IN HIGH MAGNETIC FIELDS Final Technical Report, Jul. 1972 - Mar. 1975

Paul W. Schreiber and Errol D. Beard Jun. 1975 113 p refs

(AF Proj. 7073)

(AD-A014736; ARL-75-0177) Avail: NTIS CSCL 13/1

The report presents the results of an experimental and analytical program to determine the characteristics of Xenon flash lamps in high magnetic field environments in laser systems. The radiative and electrical characteristics of Xenon flash lamps were investigated in magnetic fields up to 10 tesla. The magnet and 5 megawatt power supply were capable of producing a peak field of 14 tesla for 0.1 sec. GRA

N76-17306# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Guidance and Control Directorate.

CONCEPTS STUDY FOR NANOSECOND RISETIME MULTI-MEGAJOULE IMPULSE POWER SYSTEMS

Darryl Holder 12 Jun. 1975 12 p refs

(DA Proj. 1M3-62303-A-214)

(AD-A014985; RG-75-52) Avail: NTIS CSCL 20/3

This report considers the concepts, techniques, and limitations of means for controlling the flow of extremely high electric currents and the production of very rapid rates of change of current through a load. Impulse power systems are being incorporated in an increasing number of applications in military and research apparatus. As power and current risetime requirements are increased, more difficulties are encountered by the designer in producing an effective system. Author (GRA)

N76-17307# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanical Engineering, Aeronautical Engineering, and Mechanics.

AN ANALYSIS OF NONLINEAR RESONANCE IN THICKNESS SHEAR AND TRAPPED ENERGY RESONATORS

H. F. Tiersten Aug. 1975 46 p refs

(Contract N00014-67-A-0117-0007)

(AD-A015173; TR-14) Avail: NTIS CSCL 09/1

Electroelastic equations containing terms up to cubic in the small mechanical displacement field, but no higher than linear in the electric variables, are applied in the analysis of nonlinear resonance in rotated Y-cut quartz oscillators. Both pure thickness-shear vibrators and essentially thickness-shear trapped energy resonators are treated. Lumped parameter representations of the solutions, which are valid in the vicinity of a resonance and relate the amplitude of the dominant mode nonlinearly to the voltage across the crystal, are presented for both the pure thickness-shear and trapped energy thickness-shear problems. In each instance the expression for the current through the crystal is determined, the influence of the external circuitry is included in the analysis and, ultimately, an expression cubic in the mode amplitude and linear in the driving voltage is obtained. The analyses hold for the fundamental and odd overtone thickness-shear modes. Nonlinear resonance curves are presented for AT-cut quartz. GRA

N76-17308# Spectra Mat, Watsonville, Calif.

HIGH CURRENT DENSITY CATHODES Final Report, 1 Jul. 1973 - 1 Jan. 1975

A. P. Wynn Aug. 1975 60 p refs

(Contract DAAB07-73-C-0262; DA Proj. 1S7-62705-AH-94)

(AD-A015539; ECOM-73-0262-F) Avail: NTIS CSCL 09/1

The work performed at General Electric was repeated with as much attention to the original detail as possible. Some processes including drying, ball milling and air firing were, of necessity, performed differently due to difference in available equipment. This led to new problems which when solved gave some insights into the process and will result in more consistency in the future together with greater ease of manufacture. The cathode characteristics were similar to those obtained at General Electric both under d.c. conditions and reliability and reproducibility demonstrated. GRA

N76-17309# Texas Instruments, Inc., Dallas. Central Research Labs.

A STUDY OF NOISE IN CHARGE-COUPLED DEVICES Final Technical Report, 1 Apr. 1974 - 31 Mar. 1975

S. P. Emmons, R. W. Brodersen, J. B. Barton, C. R. Hewes, and D. D. Buss May 1975 213 p refs

(Contract N00014-74-C-0286)

(AD-A015365; TI-08-75-20) Avail: NTIS CSCL 09/1

The report describes the results of a twelve-month program that was heavily weighted toward quantitative experimental characterization designed to establish the appropriate analytic models for the various spatial and temporal noise sources in CCDs that can be used to accurately predict the limiting performance of CCD functions. Low noise input and output techniques were refined to the point that bulk trapping was observed in a four-phase, 150-stage buried channel device. Surface state trapping levels ranging from 800 to 2000 electrons were observed, in good agreement with the theoretical levels predicted using (N sub ss) values obtained for double-pulse experiments. Other noise sources treated included fixed-pattern or spatial noise, dark current, partition noise, and burst noise. GRA

N76-17310# AiResearch Mfg. Co., Torrance, Calif.

DEVELOPMENT PROGRAM FOR A LARGE PLANAR BEAM ELECTRON GUN Final Report, 18 May 1972 - 13 Dec. 1974

Arthur H. Bauer Sep. 1975 142 p

(Contract F29601-72-C-0118)

(AD-A016777; AFWL-TR-75-101) Avail: NTIS CSCL 09/1

The report presents results of a program to develop a lightweight, large planar beam electron gun. The program included design, fabrication, and test of a working model gun of less than 205 pounds with a 2000 sq cm output beam. The gun displays unique characteristics due to the use of parallel diodes, small-area thermionic emitters, titanium vacuum vessel, high-current capacity output window structure, and lightweight copper vacuum seals. Pulsed operation of the gun at voltages from 120 to 200 kv and pulse repetition frequencies up to 1000 Hz for 10- to 30-microsec pulses was a design requirement. Current densities of 9 ma/sq cm have been demonstrated at accelerating voltages up to 150 kV. Output beam uniformity has been measured by use of dosimeter paper. Uniformity of the beam is within 5 percent. Gun current efficiency as high as 70 percent has been measured. GRA

N76-17311# Naval Postgraduate School, Monterey, Calif.
A METHOD TO PREDICT THE THERMAL PERFORMANCE OF PRINTED CIRCUIT BOARD MOUNTED SOLID STATE DEVICES Final Report
Matthew D. Kellaher 31 Jul. 1975 57 p refs
(AD-A016576; NPS-59KK75071) Avail: NTIS CSCL 09/1

The objective was to formulate a design procedure to be used in the prediction of the thermal performance of printed circuit board mounted solid state devices (specifically 14 and 16 pin DIP's and TO-3 and TO-66 transistor cases). The project consists of an analytical phase which constitutes the actual formulation of the design procedure in the form of a digital computer program with appropriate documentation and an experimental phase which involves testing of actual P-C boards to verify the analytical model. GRA

N76-17312# Sperry Rand Research Center, Sudbury, Mass.
CONTROLLED INVERSION DEVICES Final Report, 1 Jul. 1974 - 30 Jun. 1975
Harry Kroger and H. A. Richard Wegener Jul. 1975 135 p refs
(Contract F19628-74-C-0074; ARPA Order 2676)
(AD-A016759; SCRC-CR-75-15; AFCRL-TR-75-0423) Avail: NTIS CSCL 09/1

Three terminal controlled inversion devices were fabricated and the properties studied. Base current drive as low as 2 microamps were sufficient to lower collector threshold voltages 0.6 V. Reliable switching of 100 mA currents was possible. Properties of devices fabricated of silicon nitride, silicon oxynitride and amorphous silicon as the thin insulator material were investigated. The reproducibility, lack of interaction between adjacent collector electrodes, and base current sensitivity of devices fabricated with polysilicon and amorphour suggest that further work on this material be emphasized. GRA

N76-17313# National Bureau of Standards, Washington, D.C. Optical Physics Div.
SEMICONDUCTOR MEASUREMENT TECHNOLOGY: OPTICAL AND DIMENSIONAL-MEASUREMENT PROBLEMS WITH PHOTOMASKING IN MICROELECTRONICS Special Publication
John M. Jerke Oct. 1975 45 p refs
(COM-75-11397/7; NBS-SP-400-20; LC-75-619190) Avail: NTIS HC $4.00 CSCL 13H

Identified are the major optical and dimensional measurement problems related to the fabrication and use of masks. The results show that the primary optical problems are those related directly to the use of optical instruments for dimensional measurements of IC pattern geometry. Futhermore, most suppliers and users of optical equipment for mask fabrication do not conduct sufficient optical testing to determine imaging performance. The basic limitations derived from light diffraction and coherence continue to limit the quality of masks and IC devices with sub-micrometer geometry, and acceptable units are produced generally on a best effort basis. GRA

N76-17314# Texas Instruments, Inc., Dallas.
PRODUCTION ENGINEERING MEASURE FOR AN INTEGRATED POWER SWITCH (IPS), VOLUME 1 Final Engineering Report, 17 May 1973 - 30 Sep. 1975
Bill H. Terrell Sep. 1975 210 p
(Contract DAAB05-73-C-2063)
(AD-A016972; TI-03-75-27-Vol-1) Avail: NTIS CSCL 09/5

The object of study was to optimize the functional design and producibility of the Integrated Power Switch and to develop the processes, production techniques, and facilities to demonstrate a production rate capability of 250 Integrated Power Switches per month. GRA

N76-17315# Texas Instruments, Inc., Dallas.
PRODUCTION ENGINEERING MEASURE FOR AN INTEGRATED POWER SWITCH (IPS), VOLUME 2 Final Engineering Report, 17 May 1973 - 30 Sep. 1975
30 Sep. 1975 83 p
(Contract DAAB05-73-C-2063)
(AD-A016824; TI-03-75-27-Vol-2) Avail: NTIS CSCL 09/5

The complete assembly and test process specifications for both the high-voltage and high-current versions of the Integrated Power Switch and their respective subassemblies are presented in detail. Each of the flow diagram control steps has an associated process specification. Several specifications are used repeatedly throughout the assembly and testing procedure. All specifications are arranged in the order in which the fabrication process first requires their use. GRA

N76-17316# Texas Instruments, Inc., Dallas.
PRODUCTION ENGINEERING MEASURE FOR AN INTEGRATED POWER SWITCH (IPS), VOLUME 3 Final Engineering Report, 17 May 1973 - 30 Sep. 1975
30 Sep. 1975 97 p
(Contract DAAB05-73-C-2063)
(AD-A016857; TI-03-75-27-Vol-3) Avail: NTIS CSCL 09/5

A complete description of pertinent quality control procedures and requirements and the expected assembly inspection yield for each of the Integrated Power Switch inspection points is given. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N76-17317* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT EXCHANGER SYSTEM AND METHOD Patent
Alexander P. Sabol, inventor (to NASA) Issued 30 Dec. 1975 5 p Filed 27 Nov. 1973 Division of abandoned US Patent Appl. SN-301419, filed 27 Oct. 1972
(NASA-Case-LAR-10799-2; US-Patent-3,929,305; US-Patent-Appl-SN-419319; US-Patent-Class-244-117A; US-Patent-Class-165-105; US-Patent-Class-165-106; US-Patent-Class-237-60; US-Patent-Class-417-209; US-Patent-Class-244-135R; US-Patent-Appl-SN-301419) Avail: US Patent Office CSCL 20D

A heat exchange system is described which includes a reservoir for a liquid coolant, a conduit for conveying coolant from the reservoir through a heating zone, and a device, such as a check valve, for preventing reverse flow in the conduit in a direction opposite to the flow of coolant from the reservoir through the heating zone. Heat applied at the heating zone causes localized boiling of the coolant which causes the coolant to move in the conduit. The check valve prevents motion in one direction and thus the coolant flows in a desired direction in the conduit from the reservoir to and through the heating zone. The heating zone may be a surface, such as an aircraft wing leading edge, which is to be cooled. The heated liquid leaves the heating zone through a further conduit and thus removes heat from the heating zone. The heated liquid may be cooled and then returned to the reservoir for further use in the system. The heated liquid may be cooled in any convenient way. In an aircraft, the heated coolant may be passed in heat exchange with the aircraft fuel.
Official Gazette of the U.S. Patent Office

N76-17318 Ohio State Univ., Columbus.
FLOW OF GASES THROUGH POROUS MEDIA Ph.D. Thesis
Ayad A. Alzaydi 1975 191 p
Avail: Univ. Microfilms Order No. 76-3367

A one dimensional flow mechanism for a multicomponent gas was described physically and represented mathematically. The steady state equations for the diffusional, forced, and combined flow were derived for a single capillary and extended to a porous medium. The diffusion process included Knudsen, molecular, and transition region diffusion. Surface diffusion was excluded since the smallest pore size in the soils tested was greater than 100 A. The work was extended to include the unsteady state combined flow equations for a multicomponent gas in a porous medium. The pore model used assumed that the soil may be represented as a bundle of parallel capillary tubes and that the flow equations may be applied to each tube

individually (assumed to be uniform in its circular cross section along its length). The individual contributions were summed over the entire pore size distribution to give the total flow. The theory was capable of including measurable physical properties of the porous medium and to relate concepts previously developed and, in special cases, was reducible to particular flow mechanisms. Dissert. Abstr.

N76-17319 Cincinnati Univ., Ohio.
AEROSOL FILTRATION BY FIXED AND FLUIDIZED GRANULAR BEDS Ph.D. Thesis
Antonio Rodriguez Figueroa 1975 241 p
Avail: Univ. Microfilms Order No. 76-3804

Basic filtration mechanisms and pertinent parameters in the filtration of aerosols by fixed and fluidized granular beds was studied to determine the feasibility of using such beds as high efficiency particle collection devices. Beds of plastic beads (polyacrylonitrile), 305 and 495 micrometers in diameter, and beds of sand, 680 micrometers in diameter were employed in 10.16 cm (4 in) diameter Lucite columns to collect small aerosol particles. Bed penetration was determined as a function of several variables: bed granule size, bed height (3, 6, and 9 cm) superficial gas velocity (3.1-18.5 cm/sec), flow direction (upflow vs. downflow), and aerosol particle size. The pressure drop across the beds was also measured. Results indicate that high collection efficiencies (low bed penetrations) (99 percent or better) can be obtained with relatively shallow (9 cm or less) fixed and fluidized beds of plastic beads. Dissert. Abstr.

N76-17320 Minnesota Univ., Minneapolis.
LOCAL MASS TRANSFER IN CORRUGATED-WALLED DUCTS AND HEAT EXCHANGER CONFIGURATIONS Ph.D. Thesis
Leonardo Goldstein, Jr. 1975 150 p
Avail: Univ. Microfilms Order No. 76-4045

Local and average air-side transfer coefficients were measured for a one-row corrugated fin and tube heat exchanger configuration. The onset and character of secondary flow longitudinal vortices, and the local and average transfer characteristics for flow in a corrugated wall channel were also experimentally investigated. The measurements were accomplished via the naphthalene sublimation technique. Local transfer coefficients for the heat exchanger configuration revealed a set of complex flow phenomena. In common with the plane fin case, the initial portion of the exchanger lies within the regime of developing boundary layer, and a strong vortex system is found adjacent to the front of the tubes. In addition, the concave streamline curvature in the flow direction is responsible for secondary flow longitudinal vortices, whose action becomes visible mostly on the lower surface. In the wake of the tube there is another vortex system. The corrugated nature of the surfaces accounts for the manner in which these vortices impact on the walls. Dissert. Abstr.

N76-17321 Iowa Univ., Iowa City.
BUOYANCY EFFECTS IN THERMALLY STRATIFIED OPEN-CHANNEL FLOW Ph.D. Thesis
Guang-Jiunn Hwang 1975 217 p
Avail: Univ. Microfilms Order No. 76-2133

The method of expansion of successive approximations for investigating the detailed flow behavior resulting from the injection of a heated effluent flow without excess momentum at the surface of a cooler ambient open channel flow. A perturbation procedure was carried out to solve numerically the convective-diffusion equation and the equations of motion simultaneously by the modified Hartree-Womersley method. These equations were solved with simulated experimental entrance conditions for the zeroth order density and the first order velocity perturbations. A set of controlled flume experiments was also conducted to obtain data for comparison with and verification of the numerical results. The selected flows covered the range from weakly to strongly stratified flows. Dissert. Abstr.

N76-17322 Colorado State Univ., Fort Collins.
INLET REGION FLOW WITH POLYMER ADDITIVES Ph.D. Thesis
Kikkeri L. V. Ramu 1975 190 p
Avail: Univ. Microfilms Order No. 76-4324

Drag reduction due to polymer injection in the inlet region and the fully developed flow region of a pipe, and the general characteristics of mean flow in the developing axisymmetric turbulent boundary layer for the inlet region of a pipe, were experimentally investigated. Experiments were conducted in a 12-in. diameter 200 ft long commercial steel pipe. Poly (ethylene oxide), commercially known as Polyox WSR 301, was injected circumferentially through a perforated injector at 3.5 diameters from the pipe entrance. Drag reduction in the inlet region was found to be a function of Reynolds number, polymer mass flow rate and distance from the injector, but was not significantly dependent on injection concentration or injection velocity. Maximum drag reduction values in excess of 90 percent were recorded in the inlet region. The location of maximum drag reduction occurred between 5 and 11 diameters downstream of the injector. Dissert. Abstr.

N76-17323 Colorado State Univ., Fort Collins.
CAVITATION DAMAGE SCALE EFFECTS: SUDDEN ENLARGEMENTS Ph.D. Thesis
Travis Earl Stripling 1975 152 p refs
Avail: Univ. Microfilms Order No. 76-4333

The cavitation damage downstream from sudden enlargement energy dissipaters was investigated. Tests were conducted on geometrically similar circular orifices of five different orifice to pipe diameter ratios in three different pipe sizes of 3-, 6-, and 12-inches. Highly polished 1100-O aluminum specimens were mounted in the downstream pipe wall to detect the cavitation damage. Two different stages or levels of cavitation damage were defined for study: (1) incipient damage level based upon maintaining a maximum pitting rate of 1 pit/sq in. min on 1100-O aluminum, (2) cavitation damage regime where the maximum pitting rate was greater than 1 pit/sq in/min. Previously defined incipient damage scaling equations based upon damage data taken in the 3-in. pipe accurately predicted the incipient damage condition in the 6- and 12-in. pipes. Pressure scale effects on the incipient damage condition were constant for all pipe sizes tested. There were no size scale effects found for the incipient damage condition based upon maintaining a maximum pitting rate of 1 pit/sq in/min. Dissert. Abstr.

N76-17324+ Societe NEYrpic-Creusot-Loire, Grenoble (France).
PERFECT AND INCOMPRESSIBLE FLUID FLOW IN TURBOMACHINES Final Report
L. R. Eremeef 30 Dec. 1974 75 p refs In FRENCH; ENGLISH summary
(Contract DGRST-73-7-1765)
Avail: NTIS HC $4.50

A method for calculating flow through an airfoil cascade drawn on a surface of revolution is discussed. The three-dimensional flow was assumed to be represented by part-channels of varying width. The basic equations are the equation of continuity and the equation of irrotationality of absolute flow. The flow developing on the flow surface was mapped into the field of velocities of a suitably chosen plane cascade flow. In this plane the variation of the part channel is treated as distribution of surface sources. Potential theory and Green's integral relations was used to obtain a system of integral equations. The solution of the integral equations can be attained only by the iterative method and gives the relative velocity distribution along the profile contour. The method is illustrated by a numerical example. Author (ESA)

N76-17325*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PARAMETRIC PERFORMANCE OF CIRCUMFERENTIALLY GROOVED HEAT PIPES WITH HOMOGENEOUS AND GRADED-POROSITY SLAB WICKS AT CRYOGENIC TEMPERATURES
M. Groll, R. B. Pittman, and J. E. Eninger (TRW Systems Group, Redondo Beach, Calif.) Dec. 1975 29 p refs
(NASA-TM-X-73095; A-6405) Avail: NTIS HC $4.00 CSCL 20M

A recently developed, potentially high-performance nonarterial wick has been extensively tested. This slab wick has an axially varying porosity which can be tailored to match the local stress imposed on the wick. The purpose of the tests was to establish the usefulness of the graded-porosity slab wick at cryogenic temperatures between 110 K and 260 K, with methane and

ethane as working fluids. For comparison, a homogeneous (i.e., uniform porosity) slab wick was also tested. The tests included: (1) maximum heat pipe performance as a function of fluid inventory, (2) maximum performance as a function of operating temperature, (3) maximum performance as a function of evaporator elevation, and (4) influence of slab wick orientation on performance. The experimental data was compared with theoretical predictions obtained with the computer program GRADE. Author

N76-17326*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
REGULARIZED NUMERICAL SOLUTION OF A NONLINEAR INVERSE HEAT CONDUCTION PROBLEM
O. M. Alifanov and Ye. A. Artyukhin Washington NASA Feb. 1976 11 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 29, Jul. 1975 p 159-164
(Contract NASw-2789)
(NASA-TT-F-16891) Avail: NTIS HC $3.50 CSCL 20M

The algorithm to obtain the stable numerical solution of inverse problem is considered for the one dimensional nonlinear heat conduction equation with moving boundaries. The problem is reduced to minimization of Tikhonov's regularization functional. The quasi-optimum parameter and discrepancy principle are used to choose the regularization parameter. The method proposed is not limited by time integration step. Author

N76-17327*# Ohio State Univ. Research Foundation, Columbus. Dept. of Mechanical Engineering.
STUDIES OF HEAT SOURCE DRIVEN NATURAL CONVECTION Ph.D. Thesis. Technical Report, Jul. 1974 - Aug. 1975
F. A. Kulacki and A. A. Emara Dec. 1975 44 p refs
(Grant NGR-36-008-205)
(NASA-CR-146395; TR-3746-2) Avail: NTIS HC $4.00 CSCL 20D

Natural convection energy transport in a horizontal layer of internally heated fluid was measured for Rayleigh numbers from 1890 to 2.17 x 10 to the 12th power. The fluid layer is bounded below by a rigid zero-heat-flux surface and above by a rigid constant-temperature surface. Joule heating by an alternating current passing horizontally through the layer provides the uniform volumetric energy source. The overall steady-state heat transfer coefficient at the upper surface was determined by measuring the temperature difference across the layer and power input to the fluid. The correlation between the Nusselt and Rayleigh numbers for the data of the present study and the data of the Kulacki study is given. Author

N76-17328*# Washington Univ., Seattle.
WALL-WAKE VELOCITY PROFILE FOR COMPRESSIBLE NON-ADIABATIC FLOWS
Chen-Chih Sun and Morris E. Childs [1975] 13 p refs
(Grant NGR-48-002-047)
(NASA-CR-146393) Avail: NTIS HC $3.50 CSCL 20D

A form of the wall-wake profile, which is applicable to flows with heat transfer, and for which a variation in y = O at y = delta, was suggested. The modified profile, which takes into account the effect of turbulent Prandtl number, was found to provide a good representation of experimental data for a wide range numbers and heat transfer. The Cf values which are determined by a least squares fit of the profile to the data agree well with values which were measured by the floating element technique. In addition, the values of delta determined by the fit correspond more closely to the outer edge of the viscous flow region than those obtained with earlier versions of the wall-wake profile. Author

N76-17329*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INFLUENCE OF PARTICLE DRAG COEFFICIENT ON PARTICLE MOTION IN HIGH-SPEED FLOW WITH TYPICAL LASER VELOCIMETER APPLICATIONS
Michael J. Walsh Washington Feb. 1976 58 p refs
(NASA-TN-D-8120; L-10258) Avail: NTIS HC $4.50 CSCL 20D

The effect of using different particle drag coefficient C sub D equations for computing the velocity of seeded particles in high-speed gas flows was investigated The C sub D equations investigated included the Stokes equation, a second incompressible equation valid for higher relative Reynolds numbers, and six equations that account for the effects of compressibility together with the effects of relative Reynolds numbers greater than one. The flows investigated were center-line nozzle flows, normal shocks, and oblique shocks for free-stream Mach numbers of 1.6 to 6 and stagnation pressures of 1 and 3.4 atmospheres. The net result was empirical C sub D equation based on the latest sphere C sub D data for the low relative Mach number and Reynolds number conditions that are encountered in supersonic flows. Author

N76-17330*# Stanford Univ., Calif.
TURBULENT BOUNDARY LAYER ON A FULL-COVERAGE FILM-COOLED SURFACE: AN EXPERIMENTAL HEAT TRANSFER STUDY WITH NORMAL INJECTION Final Report
H. Choe, W. M. Kays, and R. J. Moffat Jan. 1976 296 p ref
(Contract NAS3-14336)
(NASA-CR-2642; HMT-22) Avail: NTIS HC $9.25 CSCL 20D

Heat transfer behavior was studied in a turbulent boundary layer with full-coverage film cooling through an array of discrete holes and with injection normal to the wall surface. Stanton numbers were measured for a staggered hole pattern with pitch-to-diameter ratios of 5 and 10, an injection mass flux ratio range of 0.1 to 1.0, and a range of Reynolds number 170 thousand to 5 million. Air was used as the working fluid with the mainstream velocity varied from .14 to 33.5 m/sec (30 to 110 ft/sec). The data were taken for secondary injection temperatures equal to the wall temperature and also equal to the mainstream temperature. By use of linear superposition theory, the data may be used to obtain Stanton number as a continuous function of the injectant temperature. The heat transfer coefficient is defined on the basis of a mainstream-to-wall temperature difference. This difinition permits direct comparison of performance between film cooling and transpiration cooling. Author

N76-17331# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON A SPHERICAL EXPLOSION IN A VISCOPLASTIC MEDIUM
G. D. Babe, E. A. Bondarev, M. A. Kanibolotskii, and I. V. Shevchenko [1975] 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Tverd. Tela (Moscow), no. 4, 1975 p 158-160
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

A theoretical investigation was made of the plasticity of soils as a function of the motion caused by the explosion of a spherical charge. It was assumed that the charge immediately converted into a high pressure gas expanding according to an insentropic law with a known isentropy index, gamma, without any change in volume, at a certain time. Author

N76-17332# European Space Agency, Paris (France).
PRACTICAL PROBLEMS ON LONGITUDINAL AND CROSS-BLOWN FREE JETS: THE SIMULATION OF ENGINE JETS IN WIND TUNNELS
Nov. 1975 191 p refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/ Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 191 P Proc. of Conf. of DGLR Tech. Comm. 2A1 on 'Fixed Wing Aircraft', Porz, West Ger., 6 Dec. 1973 Original German report available from ZLDI, Munich 40.15 DM
(ESA-TT-206; DLR-Mitt-74-18) Avail: NTIS HC $7.50

The following problems occurring with free jets were dealt with: analysis of the flow field of free jets with blowing across their axis, interference effects on neighboring aircraft parts, influence of jet temperature, injector effects at higher Mach numbers, acoustic phenomena due to disturbances, and simulation of free jets in wind tunnels by solid bodies. For individual titles, see N76-17333 through N76-17341.

N76-17333 European Space Agency, Paris (France).
INVESTIGATION INTO THE FLOW FIELD OF A HOT JET IN A CROSS FLOW
Lothar Harms *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 8-40 refs Transl. into

ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 P 8-40 (For availability see N76-17332 08-34)

The flow field of a hot round jet in a cross flow was investigated in a 3m-wind tunnel. In order to find out the influence of temperature on the mixing of the turbulent jet with the cross flow, the flow field and the temperature distribution were measured in several sections up to 30 jet diameters downstream of the nozzle. Results show that the horseshoe shape deformation of the cross-blown jet with a circular cross section, which was present initially, leads to the promotion of a counter-rotating eddy pair after a short length of flow. This eddy pair limits the deflected jet on both sides and contains the jet momentum. Author (ESA)

N76-17334 European Space Agency, Paris (France).
MEASUREMENTS IN THE OUTER FIELD OF JETS BLOWN ACROSS THEIR AXIS (REPRESENTATION OF THE DIRECTION FIELD BY ISOCLINES)
Hans-Juergen Graefe *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 41-70 refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 P 41-70 (For availability see N76-17332 08-34)

The flow field of a lifting jet blown across its axis and emerging vertically from a fuselage model was determined by a directional measuring probe. This three-dimensional field is represented by isocline and streamline diagrams. The jet velocity reaches Mach number 1. The ratio of the dynamic pressure of the jet to that of the flight dynamic pressure is varied over a wide range. Author (ESA)

N76-17335 European Space Agency, Paris (France).
METHODS OF VISUALIZATION FOR FREE JET FLOW FIELDS IN WIND TUNNELS **c35**
Guenter Viehweger *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 71-83 Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen' , DGLR, Cologne Report DLR-MITT-74-18, 1974 P 71-83 (For availability see N76-17332 08-34)

Experimental methods to visualize flow fields of a free jet in a low speed wind tunnel are described. The methods used are oil smoke addition for visualization of the outer flow field and water injection for the jet region itself. ESA

N76-17336 European Space Agency, Paris (France).
THEORY OF THE ACOUSTIC FEEDBACK OF SUBSONIC FREE JETS WHICH IMPINGE ON OBSTACLES, AND COMPARISON WITH EXPERIMENTS **c71**
Guenther Neuwerth *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 84-97 refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 P 84-97 (For availability see N76-17332 08-34)

When a circular subsonic free jet impinges on an obstacle, blown flaps (STOL) or the ground (VTOL) for example, the sound pressure level is increased by about 10 dB, for certain aerodynamic and geometric parameters. The feedback mechanism, which causes this effect, reinforces the natural ordered structure of the jet turbulence - periodic ring vortices travel downstream. A pressure wave which originates from an obstacle inside the jet, spreading upstream in the jet, causes this reinforcement of the axisymmetric vortex mode. This pressure wave is explained by wave fronts travelling obliquely to the jet axis and totally reflected at the jet boundary layer. Author (ESA)

N76-17337 European Space Agency, Paris (France).
THE INJECTOR EFFECT OF FREE JETS AT HIGH MACH NUMBER **c35**
Hans-Juergen Graefe *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 98-113 refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 P 98-113 (For availability see N76-17332 08-34)

The injector effect, i.e., the entrainment of air from the vicinity of free jets at high Mach numbers, is determined by integration of the velocity profiles at several distances from the nozzle exit. The influence of the Mach number, the nozzle shape, and the initial turbulence is discussed. Author (ESA)

N76-17338 European Space Agency, Paris (France).
ON THE SIMULATION OF AN UNDEREXPANDED PROPULSIVE JET WITH EXIT MACH NUMBER M EQUALS 2.50 FOR A FLIGHT VEHICLE IN SUPERSONIC FLOW FREE STREAM MACH 4.15 (ABRIDGED VERSION) **c02**
Hans Emunds, Hansgeorg Riedel et al *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 114-122 Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 P 114-122 (For availability see N76-17332 08-34)

Tests were carried out in a 30 x 30 sq cm supersonic wind tunnel with the aim of verifying whether, for wind tunnel investigations concerning the determination of the influence of an underexpanded propulsive jet on the static longitudinal stability of a flight vehicle in supersonic flow, the jet plume of the propulsive jet can be replaced by a corresponding solid body. As the medium for the propulsive jet, cold air was used. It was found that for investigations of this kind with good accuracy a solid body jet simulation is justified provided that the influence of the surrounding flow on the contour of the jet plume of the cold air jet is taken into account in designing the solid body jet simulator. Author (ESA)

N76-17339 European Space Agency, Paris (France).
MUTUAL INTERFERENCE BETWEEN PROPULSIVE JETS AND INTERFERENCE WITH THE FUSELAGE, WING AND THE GROUND **c02**
Guenter Viehweger *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 123-165 refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen, DGLR, Cologne Report DLR-Mitt-74-18, 1974 p 123-165 (For availability see N76-17332 08-34)

The change in the normal force and pitching moment of a cylindrical fuselage caused by two lifting jets was measured. The jets, of high subsonic Mach numbers, were placed one behind the other and blown across the axis. The model allows variation of the jet diameters and their distance apart. Moreover, the position of the wing with respect to the jet nozzle was varied since its effect appears to be important. The flow parameters are: the angle of attack and the dynamic pressure of flight and jet velocity, respectively. The pressure distribution was measured on the whole central part of the cylindrical fuselage, especially in the vicinity of the nozzle exits where the interference is highest. Author (ESA)

N76-17340 European Space Agency, Paris (France).
AN ATTEMPT TO SEPARATE THE INFLUENCE OF THE INJECTOR EFFECT FROM THE DISPLACEMENT EFFECT OF A FREE JET BLOWN ACROSS ITS AXIS
Guenter Viehweger *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 166-177 Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 p 166-177 (For availability see N76-17332 08-34)

The flow field of a jet blown across its axis is determined by the injector effect as well as by the displacement of the jet. As these factors influence each other, it is difficult to apportion their effects. An attempt was made to achieve this by comparative experiments on real jets and on dummy jets of solid bodies. Author (ESA)

N76-17341 European Space Agency, Paris (France).
SYSTEMATIC INVESTIGATIONS INTO THE EFFECTS OF EXIT VELOCITY, JET TEMPERATURE AND GROUND CLEARANCE ON THE MIXING PROCESSES IN LIFTING JETS **c07**
Manfred Strauber and T. H. Darmstadt *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975

p 178-191 refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/ Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 p 178-191 (For availability see N76-17332 08-34)

The recirculation effects of VTOL aircraft were investigated. A simple basic model was used to measure the temperature fields in the region of the propulsive jets. Investigations dealt only with jet exhausts in a steady surrounding medium. Extracts from some of the results are presented. ESA

N76-17342# Naval Undersea Center, San Diego, Calif.
HYDROBALLISTICS MODELING
John G. Waugh and G. W. Stubstad Jan. 1975 357 p refs
(AD-A007529; NUC-TP-447) Avail: NTIS CSCL 16/4

A detailed treatment is presented of the various aspects of hydroballistics modeling. Included are discussions on theoretical and experimental modeling, prototype and modeling experiments, phenomenological studies, special experimental techniques, hydroballistics facilities, and the changing status of modeling. Author (GRA)

N76-17343# Tennessee Univ. Space Inst., Tullahoma.
FUNDAMENTAL STUDIES OF SUBSONIC AND TRANSONIC FLOW SEPARATION. PART 1: FIRST PHASE SUMMARY REPORT Final Report, Jun. 1972 - Dec. 1973
J. M. Wu Arnold AF Station, Tenn. AEDC Sep. 1975 129 p refs
(Contract F40600-72-C-0011)
(AD-A014802; AEDC-TR-75-95-Pt-1) Avail: NTIS CSCL 20/4

The work reported herein represents the first phase of a fundamental study of subsonic and transonic flow separation. The transonic flow wind tunnel which was specially modified for this study is described. The experimental effort includes studies of the flow over forward and rearward facing steps and shallow cavities. Such configurations are taken to be representative of flow separation over an airfoil. Theoretical work on predicting transonic flows with separation are also reported. GRA

N76-17344# General Dynamics/Convair, San Diego, Calif.
UNSTEADY TRANSONIC FLOW CALCULATIONS (TWO REPRINTS)
W. Ballhaus, R. Magnus, and H. Yoshihara 1 Sep. 1975 40 p refs
(Contract N00014-73-C-0294; NR Proj. 061-214)
(AD-A014976; CASD-NSC-75-005) Avail: NTIS CSCL 20/4

The report is composed of two reprints, the first presented at the AIAA 13th Aerospace Sciences Meeting held at Pasadena, 20-22 January 1975, while the second was presented at the Symposium on Unsteady Aerodynamics held at the University of Arizona (Tucson), 18-20 March 1975. Author (GRA)

N76-17345# Naval Postgraduate School, Monterey, Calif.
THEORETICAL INVESTIGATION OF THE FLUTTER CHARACTERISTICS OF SUPERSONIC CASCADES WITH SUBSONIC LEADING-EDGE LOCUS
James Keith Bell Jun. 1975 195 p refs
(AD-A014636) Avail: NTIS CSCL 20/4

Supersonic flow past a semi-infinite array of flat plate cascaded airfoils is analyzed using a linearized method of characteristics procedure. For a cascade having subsonic leading-edge locus, but otherwise arbitrary geometry, frequency of blade oscillation, and interblade phase angle, pressure distributions and lift forces and moments are determined. These are used for flutter analysis and the determination of flutter boundaries. In addition, the linearized method of characteristics procedure is used to analyze supersonic flow through cylindrical shells. Pressure distributions and generalized forces are computed for arbitrary radius-to-length ratios, axial and circumferential mode numbers, and frequency of panel oscillation. Author (GRA)

N76-17346# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
TURBULENT STRESS TENSORS IN A THREE-DIMENSIONAL BOUNDARY LAYER
F. J. Pierce and C. I. Ezekwe Jan. 1975 174 p refs
(Contract DAHC04-67-C-0008; AROD Proj. 6858E; DA Proj. 200-14501-B-33G)
(AD-A014954; VPI-E-75-1; ARO-6858.9-E) Avail: NTIS CSCL 20/4

One of the major objectives of this research was to determine experimentally the complete Reynolds stress tensor distribution in a pressure-driven three-dimensional turbulent boundary layer. GRA

N76-17347# Drexel Univ., Philadelphia, Pa.
A TWO-DIMENSIONAL UNSTEADY METHOD OF CHARACTERISTICS ANALYSIS OF FLUID FLOW PROBLEMS - MCDU 43 Final Contract Report, 1973 - 1975
Pei Chi Chou, Arthur Warnock, and William Flis Jul. 1975 159 p refs
(Contract DAAD05-73-C-0484; DA Proj. 1T0-61102-A-14B)
(AD-A014953; BRL-CR-252) Avail: NTIS CSCL 20/4

A computer code for solving two-dimensional, unsteady, inviscid, fluid-flow problems has been developed. Presented are details of the method-of-characteristics formulation, the treatment of the boundary conditions, and the numerical solution technique. In a sample problem of a cylindrical blast wave, the error to the exact solution is less than 0.05% at all points after 50 times planes of calculation. Author (GRA)

N76-17348# Ballistic Research Labs., Aberdeen Proving Ground, Md.
OIL FLOW STUDIES OF BASE SEPARATION AT SUPERSONIC SPEEDS Final Report
Lyle D. Kayser Aug. 1975 33 p refs
(DA Proj. 1T1-61102-A-33D)
(AD-A014981; BRL-1809) Avail: NTIS CSCL 20/4

Oil flow visualization tests were conducted on the base of a 10-degree half-angle cone model at Mach numbers 1.75 to 4.0. The cone was supported by a strut from the cone surface to the wind tunnel floor. Previous tests on a sting supported cone showed separation to occur on the cone base at distances on the order of 15% of the base radius from the trailing edge corner. Results of this test program show that separation occurs at slightly greater distances from the corner than for the sting supported model; also, the separation line was irregular indicating large asymmetries in the base flow even though the model was at zero degrees attitude. Author (GRA)

N76-17349# Ballistic Research Labs., Aberdeen Proving Ground, Md.
BOUNDARY LAYER STUDIES ON A SPINNING TANGENT-OGIVE-CYLINDER MODEL Final Report
Walter B. Sturek Jul. 1975 47 p refs
(DA Proj. 1T1-61102-A-33D)
(AD-A014878; BRL-1801) Avail: NTIS CSCL 20/4

An experimental investigation of the Magnus effect on a seven caliber tangent-ogive-cylinder model in supersonic flow is reported. The effects of surface spin, angle of attack and Mach number on boundary-layer transition have been studied using spark shadowgraphs of the flow. These shadowgraphs were taken while the model was mounted on offset struts to enable views to be obtained of the flow completely about the circumference of the model. The Magnus and normal forces were measured using the strain-gage balance technique for different boundary layer configurations. These measurements revealed a substantial sensitivity of Magnus force to the boundary layer configuration. A preliminary comparison of the Magnus measurements to the theory of Vaughn and Reis yielded poor agreement. The data have been tabulated to facilitate their use in the evaluation of proposed theoretical models of the Magnus effect. Author (GRA)

N76-17350# Princeton Univ., N.J. Gas Dynamics Lab.
RESEARCH ON SUPERSONIC TURBULENT SEPARATED AND REATTACHED FLOWS Final Report, Jul. 1973 - Apr. 1975
S. M. Bogdonoff, I. E. Vas, G. S. Settles, and G. Simpers Jun. 1975 89 p refs
(Contract F33615-73-C-4156; AF Proj. 7064)
(AD-A014769; ARL-75-0220) Avail: NTIS CSCL 20/4

Basic research programs are reported with fundamental applications to supersonic flight. The experimental studies made use of the unique capabilities of the high Reynolds number Mach 3 facility. The experimental programs concentrated on

phenomena associated with incipient separation and separation of turbulent boundary layers over a large Reynolds number range. The reattachment phenomena of a shear layer was also studied in great depth. GRA

N76-17351# New York Univ., Westbury. Aerospace and Engineering Lab.
TURBULENT BOUNDARY LAYER CHARACTERISTICS AT HIGH REYNOLDS NUMBER Final Report, 1 Sep. 1972 - 31 May 1974
Victor Zakkay Jun. 1975 53 p refs
(Contract F33615-72-C-1871; AF Proj. 7064)
(AD-A014731; ARL-75-0163) Avail: NTIS CSCL 20/4

The pressure gradient effect on the characteristics of a compressible turbulent boundary layer in separation and reattachment regions of laminar and turbulent flows has been investigated. Experiments were conducted at a large variation of Mach numbers and free stream Reynolds numbers. Favorable pressure gradient was found to have significant effect on the correlation of the total temperature and velocity profiles in turbulent boundary layer. Correlations for the separation distance, peak heating values, and peak surface pressure were found. Methods are described to predict the location and peak heating values in a separated flow region. GRA

N76-17352# New York Univ., Westbury. Aerospace and Energetics Lab.
TWO-DIMENSIONAL TURBULENT BOUNDARY LAYER SEPARATION ON A FLAT SEPARATION ON A FLAT PLATE WITH RAMP AT FREESTREAM MACH NUMBERS OF 3.7 AND 6.3 IN SUPERSONIC AND HYPERSONIC FLOW Final Report, 1 Jun. 1972 - 31 May 1974
Victor Zakkay and Nicola Paolo Jun. 1975 52 p refs
(Contract F33615-72-C-1871; AF Proj. 7064)
(AD-A014729; ARL-75-0160) Avail: NTIS CSCL 20/4

This investigation describes surface pressure distribution, heat transfer, and turbulent flow separation and reattachment on a flat plate with variable ramp angle at Mach numbers averaging 3.66 and 6.30. The freestream Reynold's number varied from 3.33 to 8.34 million per foot for the former case and from 5.243 million to 14.6 million per foot for the latter case. Ramp angle was varied from 0 to 35 degrees for these experiments. Stagnation temperatures averaged 849 degrees Rankine, with wall temperature assumed constant at 535 degrees Rankine for all tests. The knowledge of effective wedge angles and freestream conditions makes it possible to determine shocks so that conditions can be evaluated at all positions on the model. GRA

N76-17353# New York Univ., Westbury. Aerospace and Energetics Lab.
HIGH MACH NUMBER TURBULENT BOUNDARY LAYER WITH AND WITHOUT FAVORABLE PRESSURE GRADIENT Final Report, 1 Jun. 1972 - 1 Mar. 1975
Chi R. Wang Jun. 1975 133 p refs
(Contract F33615-72-C-1871; AF Proj. 7064)
(AD-A014730; ARL-75-0161) Avail: NTIS CSCL 20/4

Boundary layer profiles of total temperature and total pressure, together with surface pressure and heat transfer rates, in turbulent boundary layers with and without favorable pressure gradients were measured with a Mach 6 wind tunnel facility. Experimental results were correlated and comparisons between the cases with and without favorable pressure gradient were made. Effects of pressure gradient and upstream history to the boundary layer development were investigated. Numerical results of an existing turbulent boundary layer theory were also compared with present experiments. The surface heat transfer rates, with favorable pressure gradient, could be correlated satisfactorily with the turbulent local flat plate reference enthalpy method. With the same local free stream Reynolds number, favorable pressure gradient tends to shift the correlation of total temperature and velocity profiles from linear relation to parabolic relation. For turbulent boundary layer with favorable pressure gradient, correlation of the total temperature and velocity profiles changes from parabolic relation toward linear relation as the flow moves downstream. Author (GRA)

N76-17354# New York Univ., Westbury. Aerospace and Energetics Lab.
A STUDY OF FLOW SEPARATION IN REGIONS OF SHOCK WAVE-BOUNDARY LAYER INTERACTION IN HYPERSONIC FLOW Final Report, 1 Sep. 1972 - 31 May 1974
Michael S. Holden Jun. 1975 92 p refs Prepared in cooperation with Calspan Corp.
(Contract F33615-72-C-1871; AF Proj. 7064)
(AD-A015061; ARL-75-0162) Avail: NTIS CSCL 20/4

This report describes a theoretical and experimental investigation of the properties of attached and separated regions of shock wave-laminar boundary layer interacting in the strong interaction regime. The flow is studied over a flat plate-wedge compression surface in the high Mach number, low Reynolds number regime where the interaction between the viscous and inviscid regions over the basic flat plate is strong and of fundamental importance to the problem. The theoretical analysis treats the development of the viscous layer and its interaction with the external inviscid stream, using an integral representation for the boundary layer equations. A complementary experimental study investigated the flow over a flat plate-wedge compression surface for a range of free-stream Reynolds number and Mach number conditions in the strong interaction regime. GRA

N76-17355# Princeton Univ., N.J. Gas Dynamics Lab.
STUDY OF THREE-DIMENSIONAL FLOW FIELDS GENERATED BY THE INTERACTION OF A SKEWED SHOCK WAVE WITH A TURBULENT BOUNDARY LAYER Final Report, Apr. 1973 - Nov. 1974
B. Oskam, S. M. Bogdonoff, and I. E. Vas Wright-Patterson AFB, Ohio AFFDL Feb. 1975 227 p refs
(Contract F33615-73-C-3133; AF Proj. 1366)
(AD-A014837; AFFDL-TR-75-21) Avail: NTIS CSCL 20/4

A detailed experimental investigation has been carried out on the three-dimensional flow fields caused by the interaction of oblique shock waves and a turbulent boundary layer. The study was performed at a free stream Mach No. of 2.95, near adiabatic wall conditions. The interaction was studied on two models having the same geometries but with different initial boundary layer thicknesses (about 0.13 and 0.55 inches). By perturbing the geometry of the experimental arrangement, it was possible to define a test region that is free of extraneous interference effects. Surface pressure measurements and oil flow patterns were obtained for both models with shock generator angles varying from 2 up to 14 deg. GRA

N76-17356# Acurex Corp., Mountain View, Calif. Aerotherm Div.
INVESTIGATION OF BOUNDARY LAYER RELAMINARIZATION ON A REENTRY VEHICLE NOSETIP Final Report, 20 Sep. 1974 - 30 Mar. 1975
Calvin J. Wolf and Aemer D. Anderson May 1975 55 p refs
(Contract N60921-75-C-0052)
(AD-A014925; AEROTHERM-75-145) Avail: NTIS CSCL 16/2

A correlation for the distribution of heat transfer on a nosetip with a relaminarized boundary layer is developed and implemented in a general nosetip shape change code. A sensitivity study is made that shows that relaminarization results in significantly reduced heating rates in the sphere-cone tangent region of a reentry nosetip. This locally reduced heating is expected to have an impact, not as yet quantified, on the thermostructural performance of the nosetip. GRA

N76-17357# Stanford Univ., Calif. Thermosciences Div.
THE EFFECTS OF SYSTEM ROTATION ON SEPARATION, REATTACHMENT AND PERFORMANCE IN TWO-DIMENSIONAL DIFFUSERS
P. H. Rothe and J. P. Johnston May 1975 297 p refs
(Grant NSF GK-16450)
(PB-245321/5; SU-PD-17) Avail: NTIS HC $9.25 CSCL 13G

The report covers experimental studies of the effects of system rotation on flow in, and performance of two-dimensional diffusers of two types: (1) straight walled diffusers with smooth fairing at the inlet duct, and (2) sudden expansion, step walled diffusers. Flow regime maps and static pressure recoveries are obtained for type 1. For type 2 the basic turbulence phenomena in the

free-shear layer downstream of the step are studied and data on reattachment to the downstream wall are obtained. The important stabilizing, and destabilizing effects of rotation are emphasized. GRA

N76-17358# Hawaii Inst. of Geophysics, Honolulu.
MULTIMODE LONG WAVE TRANSPORT IN IRREGULAR BASINS Ph.D. Thesis
Frank I. Gonzalez May 1975 210 p refs
(COM-75-11459/5; HIG-75-9; NOAA-75091711; NOAA-JTRF-135) Avail: NTIS HC $7.75 CSCL 08H

A generalized separation of variables technique known as multimoding is used to treat the partial differential equations governing time-harmonic, long wave oscillations in two-port basins. Biorthogonal eigenfunction expansions are used to represent the surface elevation at each cross section of the basin (each eigenfunction in the expansion is interpreted as a spatial mode of the oscillation). The mode-amplitude coefficients of the expansion are found to be governed by a vector differential equation which evolves along the basin axis. The multimode approach reduces the original two-dimensional problem into a series of one-dimensional problems in the transverse and longitudinal directions, respectively. The second order multimode equations are decomposed into a set of coupled first order equations for the left- and right-moving components of each mode (the two-flow decomposition). GRA

N76-17359# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
THREE-DIMENSIONAL SHOCK WAVE-TURBULENT BOUNDARY LAYER INTERACTIONS AT MACH 6 Final Technical Report, Jul. - Oct. 1974
C. Herbert Law Jun. 1975 49 p refs
(AF Proj. 7064)
(AD-A014738; ARL-75-0191) Avail: NTIS CSCL 20/4

Experimental results of an investigation of the three-dimensional interaction between a skewed shock wave and a turbulent boundary layer are presented. Surface pressure and heat transfer distributions and oil flow photographs were obtained at a freestream Mach number of 5.85 and two Reynolds numbers of ten and twenty million per foot. The model configuration consisted of a shock generator mounted perpendicularly to a flat plate. The shock generator leading edge was sharp and nonswept and intersected the flat plate surface about 8.5 inches downstream of the flat plate leading edge. The shock generator surface was 7.55 inches long and 3 inches high and its angle to the freestream flow was adjusted from 4 to 20 degrees. The generated shock waves were of sufficient strength to produce turbulent boundary layer separation on the flat plate surface. GRA

N76-17360# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
TECHNIQUE FOR MEASURING THE ADIABATIC COMPRESSIBILITY, DENSITY, AND SOUND SPEED OF SUB-MICROLITER LIQUID SAMPLES Progress Report, 1 Nov. 1974 - 31 Oct. 1975
Robert E. Apfel Oct. 1975 24 p refs
(Contract N00014-67-A-0097-0023)
(AD-A016831; PR-1) Avail: NTIS CSCL 07/4

An acoustical technique for measuring a known function of the adiabatic compressibility and density of a very small liquid sample (0.000004 - 0.004 ml) has been developed. The technique involves a comparison of the conditions required for the acoustic levitation of the sample at a given position in a known, immiscible 'host' liquid and the levitation of a reference droplet of known properties at the same position. It was decided to test the validity of the procedure by using liquids of known properties so that a comparison with our results would be possible. Two particularly attractive features of the procedure are: (1) the results are independent of droplet size, and (2) the parameters of the sound field need not be known. This technique should be directly applicable to measurements of properties of superheated and supercooled liquids. GRA

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N76-17361 Colorado Univ., Boulder.
AN ELECTRON BOMBARDMENT IONIZER INCORPORATED INTO A MINIATURE MASS SPECTROMETER Ph.D. Thesis
Lars Hoivik 1975 161 p
Avail: Univ. Microfilms Order No. 76-3909

A special miniature mass spectrometer for use in pulmonary studies was developed. It is a completely portable and self-contained unit which can be suspended in any position and has the following performance characteristic: the rise time is approximately 30 milliseconds to a step change in the gas concentration for all dry gases and water vapor. This fast response time was obtained by developing a special direct inlet/ionizer system. The gas sample is conducted directly into the ionizer via a servo-controlled leak. The ionization is done by electron bombardment of the gas molecules inside the ionizer. The efficiency of the ionizer is maximized by use of an electric field gradient inside the ionizer which accelerates and focuses the ions towards the exit aperture. The mass filter is a quadrupole with delayed DC-ramps at the entrance of the filter. A minicomputer (NOVA 1200) is integrated into the mass spectrometer system. It handles the setting of the mass spectrometer as well as the processing of the output data. Dissert. Abstr.

N76-17362*# Linguistic Systems, Inc., Cambridge, Mass.
SPECTROSCOPY: CONDITIONS OF STIGMATISM FOR ROWLAND SETUPS EQUIPPED WITH CONCAVE HOLOGRAPHIC GRATINGS
Michel Pouey Washington NASA Oct. 1975 8 p refs Transl. into ENGLISH from Compt. Rend. (Paris) v. 276, no. 13, Series B, 26 Mar. 1973 p 531-534
(Contract NASw-2482)
(NASA-TT-F-16703) Avail: NTIS HC $3.50 CSCL 20F

A theoretical study was made of the possibility of using principles of focusing concave holographic gratings to design stigmatic Rowland arrangements. Data show how the focal equation can be used to determine the positions of the source points such that the variations phase registered on the surface of the gratings compensate for those resulting from deformations of the wave front caused by the gratings in the arrangement under consideration. This procedure also makes it possible to consider the making of stigmatic Rowland setups for far ultraviolet. Author

N76-17363*# Kanner (Leo) Associates, Redwood City, Calif.
COMPARATIVE THEORETICAL ANALYSIS OF TWO TYPES OF MONOCHROMATOR WITH CONCAVE GRATING FOR FAR ULTRAVIOLET SPECTROPHOTOMETRY
G. Stephan, J. C. Lemonnier, and S. Robin Washington NASA Feb. 1976 20 p refs Transl. into ENGLISH from Optica Acta (France), 1964-1965 p 345-357
(Contract NASw-2482)
(NASA-TT-F-16725) Avail: NTIS HC $3.50 CSCL 14B

A method is described which quickly furnishes the form of the image given by a two-dimensional concave grating. An IBM 1620 computer was used to perform calculations for two types of monochromator currently used in the far ultraviolet range. The image form is compared for different wavelengths, useful widths of grating, and widths of entrance slit. In a general manner, it is shown that the luminosity is a linear function of the grating width. Author

N76-17364*# Scripta Technica, Inc., Washington, D.C.
MONOCHROMATOR FOR THE 400 TO 3000 A REGION
Michel Pouey and Jacques Romand NASA Feb. 1976 20 p refs Transl. into ENGLISH from Rev. Opt. (France), v. 44, no. 9, Sep. 1965 p 445-468

(Contract NASw-2484)
(NASA-TT-F-16716) Avail: NTIS HC $3.50 CSCL 14B

A vacuum monochromator, employing a 40-cm grating, was designed to combine the capabilities of a spectrograph and a good-performance monochromator in a small-size instrument. The focusing system was computed from a general solution of the equations derived from the Fermat principle as applied to a concave grating in the special case of a magnification of 1. Examination of the Strehl criterion in the rectangular aperture case enables the accounting for higher order terms and the obtaining of a resolution of 0.3 A over the range from 400 to 3000 A. The limiting resolution, achieved under particular set-up conditions, amounts to 0.25 A within narrower spectral bands. Author

N76-17365*# Linguistic Systems, Inc., Cambridge, Mass.
TD-1A INVESTIGATION INTO THE CAUSE OF THE FAILURE OF THE NO. 1 TAPE RECORDER (TR-1)
G. Bodereau Washington NASA Feb. 1976 49 p Transl. into ENGLISH of "TD-1A recherche de la cause de la panne de l'enregistreur magnetique no. 1 (TR-1)", Rept. ESRO TR-13 (ESTEC) European Space Res. Organ., Paris, Jan. 1973 45 p
(Contract NASw-2482)
(NASA-TT-F-16715) Avail: NTIS HC $4.00 CSCL 14B

The failure of the tape recorder on the satellite TD-1A indicated a fault of a mechanical nature. The recorded data from the satellite was analyzed in an attempt to correlate the results with both a theoretical analysis of frequency sources in the recorder and with results measured on a recorder identical to the TR1. A number of possible mechanisms of failure were artificially induced in the test recorder in an attempt to reproduce the failure symptoms. The failure was shown to be due to a change in tape tension, the cause of which is still unclear but was probably a degradation of the tape lubricant. Author

N76-17366*# Linguistic Systems, Inc., Cambridge, Mass.
SPECTROSCOPY: A NEW FOCUSING METHOD FOR CONCAVE GRATINGS
Michel Pouey Washington NASA Feb. 1976 7 p refs Transl. into ENGLISH from C. R. Acad. Sci. (Paris), v. 272, Ser. B, 24 May 1971 p 1200-1202
(Contract NASw-2482)
(NASA-TT-F-16709) Avail: NTIS HC $3.50 CSCL 14B

A theoretical study of the principles of focusing concave gratings shows that it is possible to design corrected arrangements with simple rotation of the grating for values of the half-angle formed by the incident and diffracted beams of between 20 and 50 degrees. Author

N76-17367*# Kanner (Leo) Associates, Redwood City, Calif.
SEYA'S THEORY OF THE CONCAVE GRATING SPECTROMETER
H. Greiner and E. Schaeffer Washington NASA Feb. 1976 17 p refs Transl. into ENGLISH from Optik (West Germany), v. 14, no. 6, 1957 p 263-276
(Contract NASw-2481)
(NASA-TT-F-16706) Avail: NTIS HC $3.50 CSCL 14B

A survey was made of those spectrometers (monochromators) which use the concave grating employing single reflection, those which are suitable for wavelengths below 1000 A. A brief resume of Seya's theory is given. This theory provides the basis for the design of a spectrometer with fixed slits and rotatable grating for the purpose of varying wavelength. Seya's calculations are modified and extended in several respects. An explicit expression is derived for the most favorable angle between incident and reflected rays at small angles of rotation of the grating. Graphs of the focal curves for different angles of rotation of the grating show defocusing for angles deviating from the best value. It is seen that the positive orders of the spectrum involve less defocusing than the negative orders. The best grating width is estimated. Author

N76-17368*# Linguistic Systems, Inc., Cambridge, Mass.
THEORY OF A CONCAVE GRATING SPECTROMETER
H. Greiner and E. Schaeffer Washington NASA Feb. 1976 17 p refs Transl. into ENGLISH from Optik (West Germany), v. 15, issue 1, 1958 p 51-62
(Contract NASw-2482)
(NASA-TT-F-16705) Avail: NTIS HC $3.50 CSCL 14B

Apparatus constants for minimum defocussing of a concave grating spectrometer were determined. Equations were obtained relating apparatus constants, which were not obtainable in Seya theory. Numerical solutions were calculated by computer from an equation not explicitly solvable. Numerical and graphic results are given for a grating constant a= 1/600 mm. Author

N76-17369*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A 2 DEGREE/90 DEGREE LABORATORY SCATTERING PHOTOMETER Patent Application
W. R. McCluney, inventor (to NASA) Filed 13 Jan. 1976 16 p
(NASA-Case-GSC-12088-1; US-Patent-Appl-SN-648700) Avail: NTIS HC $3.50 CSCL 14B

A scattering photometer was developed for measuring the light scattered by particles in a hydrosol at substantially 2 deg and 90 deg simultaneously. Light from a source is directed by a first optical system into a scattering cell containing the hydrosol under study. Light scattered at substantially 90 deg to the incident beam is focused onto a first photoelectric detector to generate an electrical signal indicative of the amount of scattered light at substantially 90 deg. Light scattered at substantially 2 deg to the incident beam is directed through an annular aperture symmetrically located about the axis of the illuminating beam which is linearly transmitted undeviated through the hydrosol and focused onto a second photoelectric detector to generate an electrical signal indicative of the amount of light scattered at substantially 2 deg. NASA

N76-17370# Lockheed Missiles and Space Co., Palo Alto, Calif.
SPECTROZONAL COLOR AERIAL PHOTOGRAPHY
A. S. Kuchko [1975] 8 p refs Transl. into ENGLISH from the book "Aerofotografiia" Moscow, NEDRA, 1974 p 248-255 Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois

The substance of spectrozonal aerial color photography is discussed along with possible variants in the construction of spectrozonal films and a scheme to obtain a spectrozonal aerial negative. The metrological characteristics of the film and negatives are considered along with the printing of spectrozonal photographs. M.J.S.

N76-17371# RCA Labs., Princeton, N.J.
MATERIALS FOR PHASE HOLOGRAPHIC STORAGE Final Report, 1 Jan. - 31 Dec. 1974
William J. Burke, William Phillips, David L. Staebler, and Brown F. Williams Apr. 1975 72 p refs
(Contract N00019-74-C-0312)
(AD-A015206; PRRL-75-CR-21) Avail: NTIS CSCL 20/12

This report describes the recording, erasure, and fixing behavior of Fe-doped LiNbO3 at elevated temperatures and development of methods to improve the material performance. The major results of this study were: (a) The drift-like nature of the recording process at elevated temperatures was confirmed and a model to explain this effect was developed from studies of the bulk photovoltaic effect; (b) A model for the hologram erasure process at elevated temperatures was developed and tested; (c) The identification of Si as a mobile ionic species which may contribute to the fixing of holograms in Fe-doped LiNbO3. (d) The discovery that in Mn-doped LiNbO3 the recording sensitivity increases by a factor of fifty at 120C as compared with that at room temperature. These results have led to an understanding in detail of the mechanisms of hologram storage in LiNbO3. GRA

N76-17372# Army Natick Development Center, Mass.
ACQUISITION OF DROP HEIGHT DATA DURING PACKAGE HANDLING OPERATIONS Final Report, Apr. 1971 - Dec. 1974
Franklin D. Barca Jun. 1975 22 p refs
(DA Proj. 1T7-62713-D-522)
(AD-A014940; NDC-75-108-AMEL) Avail: NTIS CSCL 13/4

This report summarizes the results of various package handling studies conducted with 41cm x 31cm x 24cm, 11.3 kg containers which were instrumented with small battery operated drop height recorders and routed various transportation systems.
Author (GRA)

N76-17373# Utah Univ., Salt Lake City.
LIQUID CRYSTAL FIBEROPTIC TEMPERATURE PROBE Final Report, 1 Mar. 1974 - 28 Feb. 1975
Carl H. Durney, Curtis C. Johnson, and James L. Lords 11 Jun. 1975 21 p refs
(Contract N00014-67-A-0325-0011)
(AD-A014655) Avail: NTIS CSCL 14/2

The design, construction and testing details of a liquid crystal fiberoptic temperature probe are described. A liquid crystal sensor is attached to the distal tip of a fiberoptic probe. Pulsed light from a red LED illuminates the liquid crystal sensor through the fiberoptics and reflected red light which is strongly temperature dependent is collected. An electronic system provides all the necessary electro-optic components for the unit, including a temperature readout. Probe response data shows sensitivity, stability, hysteresis and reproducibility. A modification of the liquid crystal sensor using a thin coating of resistive material attached to the sensor tip is described by measuring electric field strength in tissues. GRA

N76-17374# Panametrics, Inc., Waltham, Mass.
DESIGN OF INSTRUMENTATION SUITABLE FOR THE INVESTIGATION OF CHARGE BUILDUP PHENOMENA AT SYNCHRONOUS ORBIT Interim Report
Jean L. Hunerwadel, Paul R. Morel, Frederick A. Hanser, and Bach Sellers Jul. 1975 61 p refs
(Contract F19628-74-C-0217)
(AD-A015063; AFCRL-TR-75-0365; SR-1) Avail: NTIS CSCL 14/2

A satellite-borne instrument has been designed to measure the charge buildup phenomena at synchronous orbit. Simultaneous measurements along two orthogonal axes are made. Each axis incorporates 4 electrostatic analyzers (ESA) and 2 solid state spectrometers (SSS). Four ESA's (low energy p, low energy e; high energy p, high energy e) and two SSS's (proton, electron) with four and five energy bins, respectively, in each analyzer provide a logical compromise of energy resolution and high time resolution. The low energy ESA's cover the energy range 0.05 to 1.7 keV; the high energy ESA's cover the 1.7 to 60 keV range. The electron SSS's cover the 30 to 10,000 keV range and the proton SSS's cover the 70 to 35,000 keV range. A complete energy spectrum is generated every 1 second. GRA

N76-17375# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
INSTRUMENTED IMPACT TESTING USING A HOPKINSON BAR APPARATUS
T. Nicholas Jul. 1975 33 p refs
(AD-A014792; AFML-TR-75-54) Avail: NTIS CSCL 14/2

A technique for conducting instrumented Charpy impact tests using a Hopkinson bar is presented. Data for three grades of beryllium covering a range in impact velocities from 20 to 200 in/sec (.5 to 5 mm/s) are obtained in the form of load-deflection curves from which maximum load, maximum deflection, and total energy are obtained. Results show good agreement with data on identical materials obtained from an instrumented impact test at 54 in/sec (1.37 m/s) and from a standard Charpy impact machine at 135 in/sec (3.43 m/s). The advantages and limitations of the Hopkinson bar apparatus are discussed. GRA

N76-17376# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
IN-PLANE DISPLACEMENT MEASUREMENTS USING SPECKLE PHOTOGRAPHS OF HOLOGRAPHIC IMAGES Final Technical Report, Sep. - Dec. 1974
Frank D. Adams Jun. 1975 26 p refs
(AF Proj. 1467)
(AD-A014791; AFFDL-TR-75-45) Avail: NTIS CSCL 14/2

In recent years, laser speckle photography has emerged as a viable tool for measuring small in-plane displacements. For example, the local displacement field near a tapered shank interference fit fastener has been measured using this new technique. In this report it is shown that speckle photographic data can be recovered from any double exposure holographic interferogram. A method for extracting in-plane displacement information from a high resolution photograph of a double exposure holographic image is presented and discussed. The technique involves generating a diffraction halo and Young's fringes in the same manner used to recover data from a conventional specklegram. GRA

N76-17377# Naval Underwater Systems Center, New London, Conn.
A NEW TECHNOLOGY FOR SUSPENDED ELECTRO-MECHANICAL CABLE AND SENSOR SYSTEMS IN THE OCEAN: A SUMMARY OF THE CABLE DEVELOPMENT PROGRAM
Richard C. Swenson and Marvin C. Goodman 12 Sep. 1975 17 p refs
(AD-A016816; NUSC-TD-5233) Avail: NTIS CSCL 13/10

This document summarizes a new technology developed explicitly for improved suspended sensor systems in the ocean. It describes briefly the systems approach, analytical techniques, synthetic strength members, cable construction, in-line sensors, fairing, buoyancy, end fittings, conductors, insulation bonding, and cost advantages currently being utilized for improved performance, versatility, and reliability at lower overall cost. It is based on the more detailed information presented in The Cable Development Program for Suspended Applications, NUSC Technical Report 4915, 22 September 1975. Author (GRA)

N76-17378# Sparcom, Inc., Alexandria, Va.
A NEW CONCEPT FOR A RAPID SURVEILLANCE ACOUSTIC BATHYMETRIC SYSTEM
G. D. Hickman May 1975 56 p refs
(Contract N00014-71-C-0202)
(AD-A016352) Avail: NTIS CSCL 08/10

An extensive study of existing data was made to determine the feasibility of using an airborne acoustic system for bathymetry of shallow waters. The total signal sound pressure for acoustic frequencies of < or equal 2000 Hz, is calculated as -132db for the case where the transceiver is located 10 meters above a smooth water surface and the water depth is 10 meters. Estimates have been made for additional losses due to rough surfaces and higher acoustic frequencies (> or equal 10 kHz). Lack of data, especially at higher frequencies, prevents a definitive statement from being made as to the feasibility of this acoustic application. GRA

N76-17379# National Center for Atmospheric Research, Boulder, Colo. Atmospheric Quality and Modification Div.
ERROR SENSITIVITY OF FIXED- AND VARIABLE-PATH LYMAN-ALPHA HYGROMETERS
Arden Buck Aug. 1975 51 p Sponsored by NSF
(PB-245730/7; NCAR-TN/EDD-103) Avail: NTIS HC $4.50 CSCL 14B

The equations developed can be applied to other absorption devices operating anywhere in the electromagnetic spectrum. The Lyman-alpha absorption hygrometer, operated in a variable-path mode, has the potential of offering both high spatial/temporal resolution and high absolute accuracy in a relatively simple instrument. The operation of absorption hygrometers in general was examined, along with some schemes for allowing self-calibration. The effects of various parameter measurement errors on humidity accuracy are calculated for both ideal and practical instruments, and error limits to achieve some arbitrary level of performance are listed. GRA

N76-17624 World Meteorological Organization, Geneva (Switzerland).
INSTRUMENTS AND METHODS OF OBSERVATION
In its Guide to Hydrol. Pract. 1974 97 p refs (For availability see N76-17623 08-43)

N76-17335 European Space Agency, Paris (France).
METHODS OF VISUALIZATION FOR FREE JET FLOW FIELDS IN WIND TUNNELS
Guenter Viehweger *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 71-83 Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen' , DGLR, Cologne Report DLR-MITT-74-18, 1974 P 71-83 (For availability see N76-17332 08-34)

N76-17337 European Space Agency, Paris (France).
THE INJECTOR EFFECT OF FREE JETS AT HIGH MACH NUMBER
Hans-Juergen Graefe *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 98-113 refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 P 98-113 (For availability see N76-17332 08-34)

36 LASERS AND MASERS

Includes parametric amplifiers.

N76-17380 Ohio State Univ., Columbus.
ABSORPTION OF DEUTERIUM FLUORIDE LASER RADIATION BY THE ATMOSPHERE Ph.D. Thesis
Frank Schriver Mills 1975 204 p
Avail: Univ. Microfilms Order No. 76-3500

Absorption of deuterium fluoride (DF) laser radiation by atmospheric gases was measured for five absorbers and 8 laser lines using a single frequency, pulsed DF laser and a large multipass absorption cell. The N2O, CH4, CO2, HDO, and H2O absorption was investigated for the 2-1 P(6), P(7), P(8), P(10), and P(11) lines and the 3-2 P(6), P(7), and P(8) lines of the DF laser. For the mid-latitude summer sea level atmospheric model the total molecular absorption coefficients are between 3.18 x .01/km and 1.16 x .1/km corresponding to a transmittance over a 10 km path of from 31 to 73 percent. Assuming the mid-latitude summer model atmosphere, the water vapor continuum absorption coefficient for the eight lines is approximately 0.02/km. The measured HDO absorption coefficients vary from 0.0006/km to 0.095/km for the lines studied and the N2O absorption coefficients vary from .002/km to 0.45/km. The CH4 absorption coefficients were found to be on the order of .001 or .0001/km. The accuracy of the measured absorption coefficients is + or - 5 percent. Dissert. Abstr.

N76-17381# Defence Research Establishment Valcartier (Quebec).
EXPERIMENTAL INVESTIGATIONS WITH A TEA-CO2 LASER WITH UNSTABLE RESONATORS [ETUDE EXPERIMENTALE D'UN LASER CO2 TEA AVEC RESONATEURS INSTABLES]
P. Lavigne, J. L. Lachambre, J. Gilbert, and G. Otis Oct. 1975 29 p refs In FRENCH; ENGLISH summary
(Proj. 97-01-20)
(DREV-R-4038/75; CRDV-R-4038/75) Avail: NTIS HC $4.00

An extensive parametric investigation of a TEA-CO2 laser operated in an unstable confocal resonator is discussed. The coupling mirror diameter and the cavity magnification giving the optimum use of the laser medium for different applications are experimentally determined. Author

N76-17382*# Scientific Translation Service, Santa Barbara, Calif.
GEOMETRIC STUDY OF THE SUPPORT STRUCTURE OF THE LASER REFLECTORS. PROJECT STARLET
M. Audibert and L. Gosset Washington NASA Feb. 1976 36 p Transl. into ENGLISH of "Etude geometrique de la structure porteuse de reflecteurs laser. Project Starlet", Rept. 72-CT/SL/EA/MS Centre Spatial de Toulouse, Div. Satellites, Dept.: Etudes and Avant-Projects, Toulouse, 1974 p 1-34
(Contract NASw-2483)
(NASA-TT-F-16718) Avail: NTIS HC $4.00 CSCL 20E

The geometric characteristics and manufacturing process are described for a laser reflector consisting of an icosahedron covered with cones. Author

N76-17383*# Southwestern Louisiana Univ., Lafayette.
POPULATION INVERSION IN CHARGE EXCHANGE COLLISIONS Final Technical Report, 1 Mar. 1975 - 28 Feb. 1976
John J. Matese 28 Feb. 1976 22 p refs
(Grant NsG-3049)
(NASA-CR-146384) Avail: NTIS HC $3.50 CSCL 20E

A theoretical model of charge exchange utilizing reasonable potential energy curves and coupling matrix elements in a two state impact parameter calculation is presented. Author

N76-17384*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A LENGTH CONTROLLED STABILIZED MODE-LOCK Nd:YAG LASER Patent Application
John Osmundson, inventor (to NASA) (NAS-NRC) Filed 5 Jan. 1976 19 p Sponsored by NASA
(NASA-Case-GSC-11571-1; US-Patent-Appl-SN-646704) Avail: NTIS HC $3.50 CSCL 20E

A method and apparatus are described for stabilizing the amplitude and repetition rate of mode-locked Nd:YAG laser pulses by controlling the laser length through a feedback loop. The end mirror of the laser is mounted on a piezoelectric crystal which is dithered at a low frequency. A portion of fundamental 1.06 micrometer laser radiation is converted into its second harmonic frequency, and the average power of the second harmonic frequency is detected by an integrating detector. The amount of the power of the second harmonic frequency depends on the match between the optical length of the laser cavity and the mode-lock frequency. The length is controlled by a feedback loop which compared the output of the second harmonic detector to the piezoelectric crystal dither signal. NASA

N76-17385# California Univ., Livermore. Lawrence Livermore Lab.
LASER FUSION SYSTEMS DESIGN STUDY Final Technical Report
Jun. 1975 172 p Sponsored by ERDA
(UCRL-13640-App) Avail: NTIS HC $11.75

Complete design specifications are given for the laser fusion research program. Data on the laser, lens system, target vidicons, alignment system, and the lens mount system are given. NSA

N76-17386# Columbia Univ., New York. Dept. of Chemistry.
CHEMICAL REACTIONS INITIATED BY INFRARED LASERS Final Report, 1 Dec. 1972 - 30 Nov. 1974
George Flynn 20 May 1975 17 p refs
(Contract F19628-73-C-0068; AF Proj. 5634)
(AD-A014831; AFCRL-TR-75-0305) Avail: NTIS CSCL 20/5

This report summarizes research in the areas of laser initiated chemical reactions, mode to mode energy transfer in polyatomic molecules, and molecular relaxation processes. Author (GRA)

N76-17387# Naval Research Lab., Washington, D.C.
THE EFFECT OF THE RECOMBINATION RATES ON THE RESONANCE LINE LASERS IN A DENSE PLASMA Interim Report
W. W. Jones and A. W. Ali Jul. 1975 9 p refs
(NRL Proj. MR-3075)
(AD-A015306; NRL-MR-3075) Avail: NTIS CSCL 07/4

The resonance transitions in hydrogen-like ions may present a road to short wavelength lasers in a dense decaying plasma. However, the rate of the depletion of the ground state into He-like ions plays an important role, at low temperatures and $z = 1$, on the inversion density. This difference is found to depend on the rate coefficients utilized. GRA

N76-17388# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala.
MEASUREMENT OF MISSILE POSITION AND ATTITUDE BY LASERS
Robert G. Conrad, Kynric M. Pell, and John E. Nydahl 30 Jul. 1975 19 p refs
(DA Proj. 1M3-62303-A-214)
(AD-A016872; RD-76-7) Avail: NTIS CSCL 17/8

This report presents a method for measuring the position and attitude of spinning rockets and missiles by the use of multiple laser trackers. While the immediate application of this system is in range instrumentation, it has potential as a guidance system - particularly for a guidance system using midcourse or terminal correction. The main advantage of a laser tracking system over existing camera tracking systems is that it would permit near real time reduction of range test data. The program objective is to obtain rocket position and attitude for determination of vehicle aeroballistic parameters from flight tests. The constraints are as follows: (1) Process real time or near time data; (2) Obtain

accuracy equal to or better than currently available; (3) Obtain data regardless of flight abnormalities; (4) Obtain high reliability for data acquisition; (5) Extend testing capability to low ambient light situation including night operation; and (6) Reduce overall cost of data acquisition and reduction. GRA

N76-17389# Washington Univ., Seattle. Dept. of Electrical Engineering.
ANALYSIS OF COUPLING EFFICIENCY BETWEEN SEMICONDUCTOR LASERS AND RECTANGULAR DIELECTRIC WAVEGUIDES Quarterly Progress Report, period ending 3 Dec. 1974
Robert B. Smith and Gordon L. Mitchell 30 Jan. 1975 32 p
(Contract N00123-73-C-1200)
(AD-A016619) Avail: NTIS CSCL 20/5

The objective of this task was coupling from (rectangular) semiconductor laser sources to a rectangular optical waveguide. As a first step, a numerical calculation of coupling efficiency was programmed for the CDC-6400 computer at the University of Washington. This report summarizes the operation and results of the program. For examples run to date, this analysis indicates that neglecting Fresnel reflection coefficient losses at the fiber and coupling efficiencies that exceed 95% can be obtained in virtually all cases. Author (GRA)

N76-17390# Texas Instruments, Inc., Dallas. Central Research Labs.
MONOLITHIC LASER Annual Technical Report, 1 May 1974 - 30 Apr. 1975
F. A. Blum, D. W. Bellavance, J. C. Campbell, F. H. Doerbeck, and K. L. Lawley Jul. 1975 55 p refs
(Contract N00014-73-C-0288; NR Proj. 215-220; RF41423001)
(AD-A016799; TI-08-75-27) Avail: NTIS CSCL 20/5

Development of a prototype integrated optical transmitter is described. These homojunction devices are wavelength-tunable monolithic electrical injection lasers and were operated between liquid nitrogen and room temperatures. Monolithic arrays of up to six mesa lasers were operated with all the lasers oscilllating simultaneously. Laser characteristics, including emission spectra, power output, and threshold current densities, were measured in detail. To improve on these characteristics single-heteorstructure mesa lasers are being developed. Results are given.
Author (GRA)

N76-17391# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
EFFICIENT HIGH-ENERGY HCl CHEMICAL LASER Semiannual Report, 15 Jul. 1974 - 15 Jan. 1975
Leonard Y. Nelson and Stanley R. Byron 15 Apr. 1975 27 p refs
(Contract N00014-75-C-0052; ARPA Order 1807)
(AD-A016611; MSNW-75-131-1) Avail: NTIS CSCL 20/5

Vibrational excitation of H2 by an electron beam stabilized discharge is being investigated as a means of improving the performance of the HCl chemical laser. Recent calculations have shown that a nearly thousand fold increase in the rate limiting Cl & H2 chain reaction step can be achieved by exciting H2. Preliminary experiments indicate substantial laser output enhancement via a stabilized discharge excitation. Diagnostics for measuring HCl (v), H2(v) and Cl2 are being assembled. GRA

N76-17392# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
RESEARCH IN LASER PROCESSES Final Report, 1 Jul. 1974 - 30 Jun. 1975
A. V. Phelps 28 Aug. 1975 22 p refs
(Contract N00014-67-A-0405-0008; ARPA Order 2683; NR Proj. 012-512)
(AD-A016610) Avail: NTIS CSCL 20/5

Calculations have been initiated to determine the threshold conditions and speed for propagation of the previously modeled constricted (arc-like) discharges which often terminate high power, electrical discharge lasers. A 'complete' set of electron collision cross sections for CO has been assembled and tested against the meager electron transport data. Measurements of the Tl-Xe fluorescence in the vicinity of the 377.6 and 535 nm lines have been used to calculate the expected gain and absorption of this promising excimer laser candidate. Measurements of integrated absorption, forward scattering and backward scattering of radiation near the resonance lines have been made over a wide range of sodium densities and quenching rate coefficients. GRA

N76-17393# Avco-Everett Research Lab., Everett, Mass.
CARBON MONOXIDE LASER Semiannual Technical Report
M. J. W. Boness and R. E. Center Sep. 1975 23 p refs
(Contract N00014-72-C-0030; ARPA Order 1807)
(AD-A016605) Avail: NTIS CSCL 20/5

The main objective of this program is the investigation of the pulsed electrical CO laser to determine the relative scaling parameters and the usefulness of high power CO lasers in systems applications. During this six month period the laser cavity and heat exchanger have been fabricated and assembled. Initial interferometric measurements indicated considerable turbulence in the flow which was greatly improved by introducing a fine stainless steel screen above the heat exchanger. However the original tests performed at a flow velocity of 50 cm/sec did not yield the desired medium uniformity and near-diffraction limited medium quality was eventually obtained by increasing the flow velocity to approximately 400 cm/sec. Currently the electrodes are being installed and the E-beam interfaced with the discharge cavity. Once completed further flow tests will be performed using the dump tank facility and the effect of the electrode structures upon the medium uniformity investigated. Finally gain and power measurements will be performed. GRA

N76-17394# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Propulsion Directorate.
FLOW VISUALIZATION IN A CHEMICAL LASER CAVITY BY PULSED LASER HOLOGRAPHY
R. W. Jones, L. B. Thorn, and K. E. Patterson 20 Jun. 1975 30 p refs
(DA Proj. 1T6-62621-AH-81)
(AD-A015557; RK-75-9) Avail: NTIS CSCL 20/6

This report presents test results of flow visualization in a chemical laser cavity. Holograms were recorded of supersonic flow from a two-dimensional slit nozzle during test runs of HF or DF lasing. Laser cavity pressure was nominally 2 torr. Holographic reconstruction gave schlierens and shadowgraphs which were used to qualitatively define Mach numbers and nozzle exit plane boundary layers. GRA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N76-17395*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ION PLATING WITH AN INDUCTION HEATING SOURCE
Talivaldis Spalvins and William A. Brainard Washington Jan. 1976 6 p
(NASA-TM-X-3330; E-8517) Avail: NTIS HC $3.50 CSCL 13H

Induction heating is introduced as an evaporation heat source in ion plating. A bare induction coil without shielding can be directly used in the glow discharge region with no arcing. The only requirement is to utilize an rf inductive generator with low operating frequency of 75 kHz. Mechanical simplicity of the ion plating apparatus and ease of operation is a great asset for industrial applications; practically any metal such as nickel, iron, and the high temperature refractories can be evaporated and ion plated. Author

N76-17396*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
KINEMATIC STABILITY OF ROLLER PAIRS IN FREE ROLLING CONTACT
Michael Savage and Stuart H. Loewenthal Washington Feb. 1976 19 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Cleveland
(NASA-TN-D-8146; E-8419) Avail: NTIS HC $3.50 CSCL 20K

A set of generalized stability equations was developed for roller pairs in free rolling contact. A symmetric, dual contact model was used. Four possible external contact profiles that possess continuous contacting surfaces were studied. It was found that kinematic stability would be insured if the larger radius of transverse curvature, in absolute value, and the smaller rolling radius both exist on the roller that has the apex of its conical surface outboard of its main body. The stability criteria developed are considered to be useful for assessing axial restraint requirements for a variety of roller mechanisms and in the selection of roller contact geometry for traction drive devices. Author

N76-17397# Materials Research Labs., Maribyrnong (Australia).
PERFORMANCE CONTROLLING PROPERTIES OF MARINE UNDERWATER BARRIER COATINGS
B. S. Smith Jul. 1975 81 p refs
(MRL-630) Avail: NTIS HC $5.00

A study was conducted to elucidate the mechanisms of failure of the barrier coatings which have been used on the underwater hull areas of ships, and to develop an accelerated screening test for the more rapid assessment of future coatings. Service failure modes were successfully reproduced in laboratory experiments with vinyl (zinc tetroxychromate pigmented, and unpigmented) and aluminium bituminous coatings, both with and without anti-fouling overcoatings. Detailed observations and mechanisms of failure of these coatings are discussed, including the performance-controlling aspects of surface preparation, osmosis, electro-osmosis, water and ion permeability, temperature and adhesion. A service experience of incompatibility of two coatings due to internal stresses is also described. Experiments to accelerate coating failure mechanisms, using applied cathodic voltages of up to 24 volts, were successful, reducing the time to failure by a factor of 5 (approx.). Limited work with a rotating disc apparatus gave encouraging results. Throughout these experiments, measurements of resistance, capacitance and current were used to follow coating performance. Author

N76-17398# Materials Research Labs., Maribyrnong (Australia).
PROCEEDINGS OF THE FIRST ORGANIC COATINGS SYMPOSIUM
J. T. Hinde, ed. and R. W. Pettis, ed. May 1975 49 p Symp. held at Maribyrnong, Australia, 17 Jul. 1974
(MRL-629) Avail: NTIS HC $4.00

The purpose of the symposium was to help these laboratories provide more effective and more comprehensive assistance to the Armed Services and government factories in the painting and protection of equipment and supplies. The lectures covered recent technical developments in paint and application techniques. Also by describing typical tasks undertaken for the Armed Services, the type and extent of practical assistance was indicated which these laboratories can offer in the solution of painting and protection problems. Author

N76-17399*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMIC SEALING PRINCIPLES
John Zuk 1976 56 p refs Proposed for presentation at Conf. on Theory and Pract. of Lubrication, Dayton, Ohio, 26-29 Apr. 1976; sponsored by Dayton Univ.
(NASA-TM-X-71851; E-8587) Avail: NTIS HC $4.50 CSCL 11A

The fundamental principles governing dynamic sealing operation are discussed. Different seals are described in terms of these principles. Despite the large variety of detailed construction, there appear to be some basic principles, or combinations of basic principles, by which all seals function, these are presented and discussed. Theoretical and practical considerations in the application of these principles are discussed. Advantages, disadvantages, limitations, and application examples of various conventional and special seals are presented. Fundamental equations governing liquid and gas flows in thin film seals, which enable leakage calculations to be made, are also presented. Concept of flow functions, application of Reynolds lubrication equation, and nonlubrication equation flow, friction and wear; and seal lubrication regimes are explained. Author

N76-17400*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ISOTHERMAL ELASTOHYDRODYNAMIC LUBRICATION OF POINT CONTACTS. 2: ELLIPTICITY PARAMETER RESULTS
Bernhard J. Hamrock and Duncan Dowson (Leeds Univ., England) Washington Feb. 1976 21 p refs
(NASA-TN-D-8166; E-8467) Avail: NTIS HC $3.50 CSCL 13I

A numerical solution of the isothermal elastohydrodynamic problem for point contacts is presented which reproduces all the essential features of experimental observations based upon optical interferometry. In particular, the two side lobes, in which minimum film thickness regions occur, emerge in the theoretical solutions. The influence of the ellipticity parameter on solutions to the point contact problem is explored. The ellipticity parameter k was varied from 1 (a ball on a plate) to 8 (a configuration approaching line contact). It is shown that the minimum film thickness can be related to the well known line contact solutions by a remarkably simple expression involving either k or the effective radius of curvature ratio R sub y/R sub x. Author

N76-17401*# Bureau of Mines, Minneapolis, Minn. Mining Research Center.
EXPERIMENTAL SYSTEM FOR DRILLING SIMULATED LUNAR ROCK IN ULTRAHIGH VACUUM
Wallace W. Roepke Jan. 1975 12 p refs
(NASA Order R-09-040-001)
(NASA-CR-146419) Avail: NTIS HC $3.50 CSCL 13I

An experimental apparatus designed for studying drillability of hard volcanic rock in a simulated lunar vacuum of 5 x 10 to the minus 10th power torr is described. The engineering techniques used to provide suitable drilling torque inside the ultrahigh vacuum chamber while excluding all hydrocarbon are detailed. Totally unlubricated bearings and gears were used to better approximate the true lunar surface conditions within the ultrahigh vacuum system. The drilling system has a starting torque of 30 in-lb with an unloaded running torque of 4 in-lb. Nominal torque increase during drilling is 4.5 in-lb or a total drilling torque of 8.5 in-lb with a 100-lb load on the drill bit at 210 rpm. The research shows conclusively that it is possible to design operational equipment for moderate loads operating under UHV conditions without the use of sealed bearings or any need of lubricants whatsoever. Author

N76-17402# European Space Agency, Paris (France).
SPACE TRIBOLOGY
T. D. Nguyen, ed. and B. T. Battrick, ed. Oct. 1975 411 p refs Partly in FRENCH and partly in ENGLISH Proc. of the 1st European Space Tribology Symp., Frascati, Italy, 9-11 Apr. 1975
(ESA-SP-111) Avail: NTIS HC $11.00

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N76-17403 RCA Labs., Princeton, N.J. Astro-Electronics Div.
THE DESIGN OF MOMENTUM WHEELS AND SOLARARRAY DRIVES FOR LONG-LIFE SPACECRAFT
D. Binge and R. Treadwell *In* ESA Space Tribology Oct. 1975 p 71-85 refs (For availability see N76-17402 08-37) (Contract F04701-72-C-0221)

The design, development, and qualification of solar array drives and momentum, or reaction, wheels for long-life spacecraft, the DMSP Block 5D medium-altitude, three-axis satellite and the RCA Satcom geostationary communications satellite, are described. Solar array power is in the 1000 W range; reaction torques range up to 0.14 Nm and angular momentum up to 30 kg sq m per second. Emphasis is placed on design concepts and techniques developed to achieve lightweight, high reliability, low power consumption, low torque jitter, low wear of bearings and slip rings, and high probability of survival for missions with a design life of as much as 8 years. More than 15 years of spacecraft flight experience provides the background for these techniques. Author (ESA)

N76-17404 Aerospace Corp., El Segundo, Calif.
A CONCEPT OF DESPIN MECHANICAL ASSEMBLY LIFE-TESTING INVOLVING TOTAL CHARACTERISATION
S. Feuerstein and A. S. Forster *In* ESA Space Tribology Oct. 1975 p 115-122 refs (For availability see N76-17402 08-37) (Contract F04701-74-C-0075)

A concept of total mechanical assembly life testing through comprehensive instrumentation for early detection of system degradation is presented. Testing criteria and appropriate measurement techniques are discussed. On the basis of this approach, an advanced technology test program was initiated in 1972. Author (ESA)

N76-17405 Aerospace Corp., El Segundo, Calif.
PRELIMINARY RESULTS OF AN ADVANCED TECHNOLOGY DESPIN MECHANICAL ASSEMBLY LIFE TEST PROGRAMME
A. S. Forster and S. Feuerstein *In* ESA Space Tribology Oct. 1975 p 123-141 refs (For availability see N76-17402 08-37) (Contract F04701-74-C-0075)

A comprehensive test program developed to acquire an experimental and analytical data base for the verification of spacecraft Despin Mechanical Assemblies (DMA) design rationale is presented. Structurally, the test program was organized to systematically identify and characterize DMA lubricant supply and transfer mechanisms, and establish real-time test guidelines and procedures as a basis for the formulation of reliable confidence levels. Formulation of the test program, data reduction techniques, measurement techniques, test criteria and preliminary test results are covered. Author (ESA)

N76-17406* Poly-Scientific Corp., Blacksburg, Va.
FRICTION, WEAR AND NOISE OF SLIP RING AND BRUSH

CONTACTS FOR SYNCHRONOUS SATELLITE USE
E. Lewis (Poly-Sci. Corp.), S. R. Cole (Poly-Sci. Corp.), E. W. Glossbrenner (Poly-Sci. Corp.), and C. E. Vest *In* ESA SPACE Tribology Oct. 1975 p 367-378 refs (For availability see N76-17402 08-37)
(Contract NAS5-21146)

A study was completed for the testing of power slip rings for synchronous orbit application. Instrumentation systems necessary for monitoring electrical-contact noise, friction and brush wear at atmospheric pressure and at less than 0.05 microtorr were used. Composite brushes consisting of silver-molybdenum disulphide-graphite and silver-niobium diselenide-graphite were run on rings of coin silver and rhodium plate. Brush materials were initially characterized by elemental analysis, density, electrical resistivity, shear strength and microstructure. Each of the four contact combinations were tested during an ambient condition run-in at 150 rpm and a humidity sequence at 0.1 rpm prior to undergoing a two-year test. The data from the two years of vacuum operation and the results from a detailed post-test analysis are presented. Author (ESA)

N76-17407# Columbia Univ., New York.
COMPUTATIONAL KINEMATICS IN THE ANALYSIS, SYNTHESIS AND DESIGN OF MECHANISMS Final Report, 1 Jul. 1972 - 30 Jun. 1975
F. Freudenstein 8 Aug. 1975 10 p refs
(Contract DAHC04-72-C-0032)
(AD-A015576; ARO-9872.2-E; TR-6) Avail: NTIS CSCL 13/9

The report describes the results of research in the areas of mechanisms and mechanical systems, as follows: (1) Principles of logical functional design of mechanisms and mechanical systems; (2) Development of efficient computer-aided design techniques for unit mechanisms--(a) tone arm articulation for minimum tracking error in automatic turntables (b) transmission-angle optimization of a skew four-bar linkage (c) rotatability criteria for the cranks of a geared five-bar mechanism; Development of general methods of computer-aided kinematic design--(a) synthesis of numerically specified cam-follower systems (b) development of heuristic combinatorial design methods for mechanisms and mechanical systems of small to moderate size. GRA

N76-17408# Franklin Inst. Research Labs., Philadelphia, Pa.
TESTING OF ELASTIC MOUNTS FOR APPLICATION IN BEARINGS Interim Report
I. Anwar and F. Kramberger Aug. 1975 98 p refs
(Contract Nonr-2342(00); NR Proj. 062-316)
(AD-A017504; FIRL-I-C2429) Avail: NTIS CSCL 13/9

Recently there has been considerable interest in the development of compliantly mounted rigid pad bearings. To analyze this type of bearing mathematically requires the solution of fluid equations to determine the film behavior and elastic equations that govern the deformation of the compliant member bonded between the rigid members. However, an approximate analysis may be carried out by solving the fluid equations and the deformation equations independently with the common condition that the fluid film force and the moment are in equilibrium with the reaction force and the moment from the elastic mount. GRA

N76-17409# Army Materials and Mechanics Research Center, Watertown, Mass.
DESIGN ANALYSIS, TESTING, AND RELIABILITY OF JOINTS, AN ANNOTATED BIBLIOGRAPHY Final Report
Margaret M. Murphy and Edward M. Lenoe Sep. 1975 168 p refs
(AD-A015531; AMMRC-MS-75-7) Avail: NTIS CSCL 13/5

An annotated bibliography of the work reported in the literature (1969-June 1975) on joining technology is presented. The bibliography covers experimental as well as theoretical aspects of the engineering methodology and considers a wide variety of types of joints, fracture mechanics aspects, nondestructive test procedures, reliability, and materials science considerations in joining structural materials. GRA

N76-17410# Catholic Univ. of America, Washington, D.C. Vitreous State Lab.
VISCOELASTIC CHARACTERIZATION OF LUBRICANTS UNDER TRANSIENT NON-LINEAR STRESS CONDITIONS
Charles J. Montrose, James F. Dill, and Robert Moeller Aug. 1975 23 p refs
(Contract N00014-75-C-0585; NR Proj. 229-007)
(AD-A014910; TR-4) Avail: NTIS CSCL 11/8

The characterization of the behavior of a lubricant in an elastohydrodynamic contact is shown to depend upon the nonlinear viscoelastic response of the fluid. This response can be obtained from the experimentally determined linear viscoelastic properties of the lubricant. An experimental program for the measurement of these properties is outlined and some illustrative results are given. Methods of treating the data and the implications of the data thus far obtained are briefly summarized. The directions in which continued investigation is likely to prove most successful are examined and a specific research program along these lines is sketched. GRA

N76-17411# Rhode Island Univ., Kingston. Coll. of Engineering.
FUNDAMENTAL AND PRACTICAL EVALUATION OF THE CERAMIC FINISHING PROCESS Final Technical Report, 15 Nov. 1972 - 15 Nov. 1974
P. J. Gielisee, T. J. Kim, L. F. Goyette, and R. V. Nagarkar 15 Nov. 1974 115 p refs
(Contract N00019-72-C-0202)
(AD-A015088) Avail: NTIS CSCL 11/2

The geometric and kinematic modes of material removal have been determined for four types of aluminas under differing environmental conditions and for various system parameters. The effect of various liquid environments on the force levels generated in single point diamond grinding of three alumina ceramics has been determined. The liquids used were water, n-alkanes, n-alcohols, toluene and carbon tetrachloride. The effects of these liquids were compared with the dry environment grinding conditions. The force levels and the amount of stock removed appear to be higher as the chain length of n-alcohols increases. There are sharp deviations from the expected direct relationship between the observed forces on one hand, and the kinematic viscosity and the chain length of the liquids on the other hand. The effects of microstructural parameter, the grain size, on the magnitude of forces generated while grinding hot-pressed, fully dense alumina (Al_2O_3) with a single point diamond wheel were experimentally investigated. GRA

N76-17412# AiResearch Mfg. Co., Phoenix, Ariz.
HIGH TEMPERATURE, HIGH SPEED SOLID LUBRICATED BEARING TECHNOLOGY. PHASE 2: TEST AND ANALYSIS Technical Report, 1 Jun. 1974 - 31 May 1975
Paul R. Bissett, Richard L. Downey, and Robert A. Solomon Jul. 1975 96 p refs
(Contract F33615-73-C-2020; AF Proj. 3048)
(AD-A015042; AiResearch-74-410569-2; AFAPL-TR-74-77) Avail: NTIS CSCL 13/9

This report describes a thorough analysis of the heat transfer characteristics of solid lubricated bearings. Two major aspects are investigated. These are heat generation within the bearing, and bearing cooling techniques. Bearing heat generation was studied, both analytically and experimentally. Computerized heat generation predictions were made and compared to actual performance data. Bearing component experiments were conducted in order to determine material and geometric effects and the significance of the various heat transfer modes. In addition, the importance of bearing operating conditions upon heat generation was also determined. A number of bearing cooling techniques were investigated. The influence of bearing geometric changes and cooling medium supply methods were determined. Much of the data is presented in nondimensional form. In general, it was found that heat generation was more a function of bearing operating conditions, especially speed and thrust load, than bearing internal geometry. Direct jet impingement cooling appears to be the most effective bearing cooling technique. Author (GRA)

N76-17413# Aluminum Co. of America, Alcoa Center, Pa.
OPTIMIZATION OF EQUIPMENT AND TECHNIQUES FOR WELDING ALUMINUM IN THE THICKNESS RANGE OF ABOUT 1/16 TO 1/4 INCH Final Report, 28 Jun. 1974 - Jul. 1975
Richard K. Sager, Paul B. Dickerson, James E. Grant, Walter R.

Reichelt, and Maurice C. Sharp 29 Sep. 1975 207 p refs (Contract N00024-74-C-5502)
(AD-A016837) Avail: NTIS CSCL 13/8

The laboratory phase of this contract fabricated fillet welded panels, using gas metal arc welding (GMAW), pulsed GMAW, high-frequency resistance welding, explosion welding, and electron beam weldtrusion (inchamber). Butt weld investigations included conventional GMAW, plasma GMAW, and sliding seal electron beam (out of chamber). For conventional GMAW welding, power sources, shielding gas mixtures, and travel speeds were evaluated for their effect on panel distortion, joint soundness and strength. All of the specimens were evaluated for static and fatigue strength, corrosion fatigue, corrosion resistance, hardness, residual stress, shrinkage, heat input and distortion. The contract analyzes the results of fabrication and evaluation of the fabricated specimens, along with equipment costs and economics to attempt to determine the optimum weld process for various types of ship construction. GRA

N76-17414# Pennsylvania State Univ., University Park. Applied Research Lab.
AXIAL FLOW ROTOR UNSTEADY RESPONSE TO CIRCUMFERENTIAL INFLOW DISTORTIONS
E. P. Bruce and R. E. Henderson 13 Aug. 1975 53 p refs (Contract N00017-73-C-1418)
(AD-A016298; TM-75-208) Avail: NTIS CSCL 13/7

The unsteady response of an axial flow fan rotor to steady, circumferential inflow velocity distortions has been evaluated by investigation of the unsteady normal force and pitching moment on a chordwise element of a rotor blade. Experimental measurements of these unsteady characteristics are presented as a function of the geometry of the rotor -- stagger angle, solidity and steady angle of incidence -- for sinusoidally varying circumferential distortions with different numbers of distortion cycles. These measurements are compared with two theoretical analyses. GRA

N76-17415# Pennsylvania State Univ., University Park. Applied Research Lab.
DEVELOPMENT OF A WOBBLE PLATE SLURRY PUMP M.S. Thesis
Gary L. Smith 9 May 1975 74 p refs
(Contract N00017-73-C-1418)
(AD-A016609; TN-75-153) Avail: NTIS CSCL 13/11

Conventional pumps are inappropriate for slurry transport because of the solids which wrap or accumulate into masses. If efficiency is to be maximized, pumps must be designed for unrestricted passage of the solids material they are to transport. The objectives of this research were to analytically predict the performance of a scaled up experimental wobble plate pump and compare this design with the performance of the experimental wobble shredder pump. An experimental analysis was made to determine the effect of changing the angle of the wobble plate and the capability of the pump to transport slurry material. A wobble shredder pump reported herein was designed to handle fibrous material and other solids. The research was undertaken especially to solve the problem of transporting sewage, cannery waste, pulp, packing plant waste, and liquid manure. GRA

N76-17416# National Bureau of Standards, Washington, D.C.
FEASIBILITY STUDY FOR A DIESEL ENGINE CONDITION MONITORING SYSTEM FOR 1179 CLASS LST'S Final Report
D. Dominy (Mech. Technol., Inc.), J. Frarey (Shaker Res. Corp.), H. Hegner (Gen. Am. Transportation Corp.), M. Peterson (Wear Sci., Inc.), and H. C. Burnett 30 Jul. 1975 105 p refs
(AD-A016782; NBS-GCR-75-43) Avail: NTIS CSCL 21/7

A study of the maintenance costs and practices on the LST 1179 class ship has been made to determine if a propulsion diagnostic system would result in cost savings to the Navy or other advantages. In the course of this study, a determination of the current propulsion system malfunctions was made and a listing prepared of the necessary sensor measures to detect these malfunctions Based upon this information, a diagnostic system was proposed and costed. For the LST 1179 ships a simple data system, which measures the trend analysis parameters (plus critical malfunctions), was found to be cost effective. Its cost would be approximately $25,000 per ship per year. GRA

N76-17268 Southampton Univ. (England). Inst. of Sound and Vibration Research.
NOISE CHARACTERISTICS OF AXIAL AND CENTRIFUGAL FANS AS USED IN INDUSTRY
B. D. Mugridge *In* Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 7, No. 9 Sep. 1975 p 93-107 refs (For availability see N76-17266 08-31)

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N76-17417*# Boeing Aerospace Co., Houston, Tex.
VIBRATION DETECTION OF COMPONENT HEALTH AND OPERABILITY Final Report
Bruce C. Baird 22 Dec. 1975 171 p refs
(Contract NAS9-14169)
(NASA-CR-147433) Avail: NTIS HC $6.75 CSCL 14D

In order to prevent catastrophic failure and eliminate unnecessary periodic maintenance in the shuttle orbiter program environmental control system components, some means of detecting incipient failure in these components is required. The utilization was investigated of vibrational/acoustic phenomena as one of the principal physical parameters on which to base the design of this instrumentation. Baseline vibration/acoustic data was collected from three aircraft type fans and two aircraft type pumps over a frequency range from a few hertz to greater than 3000 kHz. The baseline data included spectrum analysis of the baseband vibration signal, spectrum analysis of the detected high frequency bandpass acoustic signal, and amplitude distribution of the high frequency bandpass acoustic signal. A total of eight bearing defects and two unbalancings was introduced into the five test items. All defects were detected by at least one of a set of vibration/acoustic parameters with a margin of at least 2:1 over the worst case baseline. The design of a portable instrument using this set of vibration/acoustic parameters for detecting incipient failures in environmental control system components is described. Author

N76-17418# Army Tropic Test Center, APO New York 09827.
MATERIEL TESTING IN THE TROPICS, 4TH EDITION
Jun. 1975 169 p refs
(AD-A015426; USATTC-7503001) Avail: NTIS CSCL 15/5

The US Army Tropic Test Center (USATTC) presents the 1975 update of Tropic Environmental Effects, retitled Materiel Testing in the Tropics. The handbook is a compendium of the US Army's experience in testing equipment in the humid tropics. Sources of information are tropic materiel tests, test methodology investigations, personal experiences, open literature, Department of Defense reports, and voluntary contributions from many scientists and engineers outside of USATTC. The document is the US Army's unofficial corporate memory of tropic materiel testing. Topics covered include the Panama Canal Zone environment, history of tropic tests, degrading environmental factors, materiel degradation, tropic reliability and maintainability, vehicular mobility testing, sound, visibility, and radio propagation, human factors engineering, working in the jungle, man-pack probability and computerized test site selection methods. GRA

N76-17419# Army Armament Command, Rock Island, Ill. Systems Analysis Office.
GENERAL STATISTICAL PROCEDURES: PARAMETER ESTIMATION USING WEIBULL DISTRIBUTION, RELIABILITY TEST OF HYPOTHESIS, AND COMPUTATION OF EXPECTED NUMBER OF RENEWALS Final Report
Thomas N. Mazza and Robert C. Banash Aug. 1975 26 p refs
(AD-A015536; SAO/N-07) Avail: NTIS CSCL 14/4

This addendum details the statistical procedures used in preparing the report, Decision Risk Analysis for XM204, 105mm Howitzer, Towed Reliability/Durability Requirements (AD-763204). A computer program was developed for this study to simulate DT/OT II testing analysis of data, the decision made

based on this analysis, and the funding implications of this decision. A two-parameter Weibull family was assumed to describe durability failures. The test results were used to estimate the two parameters for each subsystem: carriage, recoil system, tube, and breech. This was followed by a test of hypothesis which tested whether sufficient information was available to reject the hypothesis that the required durability had been obtained. The subsystem durability was then used to compute replacement requirements over the system lifetime. GRA

N76-17420# Naval Weapons Center, China Lake, Calif.
BINOMIAL RELIABILITY CURVES FOR PLANNING AND ASSESSMENT Final Report, Jan. - Mar. 1975
D. R. Cruise, G. A. Tabb, and I. S. Kurotori Aug. 1975 115 p refs
(AD-A015124; NWC-TP-5728) Avail: NTIS CSCL 14/4

Graphs are presented that (1) guide the user in determining the numbers of items to be tested to determine lower reliability limits (R sub L) at a confidence level (C sub L), (2) establish (R sub L) at (C sub L) after testing N(sample size) items, (3) given the true reliability, allow determination of the probability of failing to demonstrate (R sub L), (4) provide an operating characteristic curve for a given N and the number of items in a sample that pass a given test (S), (5) establish upper reliability limits, given N and S, and (6) allow utilization of the Bayesian approach. GRA

N76-17421# Texas Technological Univ., Lubbock. Dept. of Industrial Engineering.
AN EMPIRICAL BAYES ATTRIBUTE CONTROL CHART FOR PROCESS FRACTION DEFECTIVE
Harry F. Martz, Jr. and Prestone C. Chen 31 Jul. 1975 56 p refs
(Contract N00014-75-C-0832; NR. Proj. 042-320)
(AD-A014621; TR-6) Avail: NTIS CSCL 13/8

An empirical Bayes attribute control chart is developed for monitoring the fraction defective of a process (p-chart). The procedure requires no specific assumption regarding the incoming (prior) process distribution. Binomial sampling is assumed. The performance of the method is examined by means of extensive Monte Carlo simulation. Comparisons are made with the usual classical p-chart. In all cases the Empirical Bayes p-chart has larger power for detecting a shift in the mean of the process distribution. The procedure performs best when the process variation is small. The power is very large for detecting moderate shifts in the process mean. Finally, two real-data applications are presented, discussed, and appropriate conclusions drawn. GRA

N76-17422# Technology, Inc., Dayton, Ohio.
REST LINEAR UNBIASED PREDICTION OF ORDER STATISTICS IN EXPONENTIAL AND PARETO POPULATIONS Interim Report, 1 Jun. - 29 Aug. 1973
Kenneth S. Kaminsky Jun. 1975 24 p refs
(Contract F33615-71-C-1463; AF Proj. 7071)
(AD-A014740; ARL-75-0201) Avail: NTIS CSCL 14/4

In many life-testing and reliability situations it is desirable to be able to predict the time of future failures from the times of early failures. Interval prediction for this problem has been treated by several authors. In this report, the author gives best linear unbiased (blu) point predictors of future failures from the early failures when the underlying failure distribution is exponential or Pareto. He also derives the blu estimates of the parameters of the Pareto distribution. GRA

N76-17423# Southwest Research Inst., San Antonio, Tex.
NONDESTRUCTIVE TESTING DATA SUPPORT CENTER. THE FIRST YEAR Annual Technical Report, 15 Feb. 1974 - 15 Feb. 1975
C. G. Gardner Sep. 1975 59 p
(Contract DSA900-74-C-5268)
(AD-A015593; SwRI-15-3903-1; AMMRC-CTR-75-19) Avail: NTIS CSCL 05/2

The Nondestructive Testing Data Support Center began operating in March, 1974, charged to provide needed support to the DoD Nondestructive Testing Information Analysis Center operated by the Army Materials and Mechanics Research Center, and to meet all requirements of a DoD full-service information analysis center of technical excellence in the field of nondestructive testing. At the close of its first year, all major areas of operation were, with one exception, functioning normally. An Information Support System including currently a total of 7,997 computer retrievable bibliographic data records was established; the ISS employs a Defense RDT and E on-line system remote terminal supported by the Defense Documentation Center. Publication of two current awareness and promotional serials was begun; these are the promotional NTIAC Bulletin, currently distributed free to approximately 4500 recipients and the more technical NTIAC Newsletter, currently distributed to approximately 150 paid subscribers. GRA

N76-17424# Army Materiel Command, Texarkana, Tex. Intern Training Center.
APPLICATIONS OF THE AUTOCORRELATION FUNCTION AND FOURIER ANALYSIS TO QUALITY CONTROL Final Report
Harry Branch Tanner Apr. 1975 76 p refs
(AD-A016789; USAMC-ITC-02-08-75-020) Avail: NTIS CSCL 14/4

This research investigates the feasibility of using Fourier Transform Theory and the autocorrelation function for the purpose of detecting when a process is out-of-control. Two methods are proposed, one using the spectral density of process data and the other using the autocorrelation of the process data. Density functions of the test statistic in each case are derived with the assumption that the process data is normally distributed. The results of simulations ran to verify the derived distributions are given, and comparisons are made between the effectiveness of the two proposed methods and a concentional control chart. The author feels that these methods are of interest to persons concerned with quality control, but should not be applied until more research is performed. GRA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N76-17425 Virginia Polytechnic Inst. and State Univ., Blacksburg.
DEGREE OF STABILITY OF A SHALLOW SPACE TRUSS Ph.D. Thesis
Kamol Wongkoltoot 1975 128 p
Avail: Univ. Microfilms Order No. 76-3876

The objective of this study was to develop a practical method for the determination of the degree of stability of a shallow space truss. The degree of stability is a quantitative measure of disturbances equilibrium can sustain. It forms a basis of a sufficient condition of stability of equilibrium relative to finite disturbances. The potential energy difference between the equilibrium state in question and the nearest unstable equilibrium state was used as a measure of the degree of stability. The degree of stability is determined by the static analysis via nonlinear programming and static perturbation techniques. With the degree of stability determined, the stability of equilibrium is tested relative to instantaneous and transient disturbances. For an instantaneous disturbance, stability can be ascertained from the initial conditions. The test for stability relative to a transient disturbance requires the knowledge of the perturbed motion for the duration of the disturbance. The study indicates that the static perturbation technique represents a practical tool for the determination of the degree of stability of space truss. Dissert. Abstr.

N76-17426*# Astro-Space Labs., Inc., Huntsville, Ala.
THE DESIGN, DEVELOPMENT, FABRICATION AND TESTING OF TWO (2) NON-SPIN PLATFORMS, (NSP) Final Report
5 Sep. 1975 96 p refs Revised
(Contract NAS8-30528)
(NASA-CR-144178; D180-19335-1-Rev-A) Avail: NTIS HC $5.00 CSCL 20K

The non spin platform is a means for achieving the very

low acceleration requirements for cost effective space processing experiments on research rocket flights. These platforms have a low initial cost, are re-usable and have extremely low refurbishment cost. In order to attain this goal, commercially available components were used and only the necessary quality control standards were imposed. A detailed system description, the very few design problems encountered, the operational procedures (both pre-flight and post-flight), and the maintenance requirements are described. Author

N76-17427*# National Aeronautics and Space Administration. Pasadena Office, Calif.
A MACHINE FOR USE IN MONITORING FATIGUE LIFE FOR A PLURALITY OF ELASTOMERIC SPECIMENS Patent Application
George E. Fitzer, inventor (to NASA) (JPL) Filed 29 Jan. 1976 18 p
(Contract NAS7-100)
(NASA-Case-NPO-13731-1; US-Patent-Appl-SN-653681) Avail: NTIS HC $3.50 CSCL 20K

An improved machine for use in determining the fatigue life for elastomeric specimens is disclosed. The machine is characterized by a plurality of juxtaposed test stations, specimen support means located at each of the test stations for supporting a plurality of specimens of elastomeric material, and means for subjecting the specimens at each station to sinusoidal strain. The strain rate is unique with respect to the strain rate at which the specimens at each of the other stations is subjected to sinusoidal strain. NASA

N76-17428# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE RELATIONSHIPS AND METHODS OF MODERN PLASTICITY
A. A. Iliushin and V. S. Lenskii [1975] 20 p refs Transl. into ENGLISH from the book "Uspekhi Mekhanikik Deformiruemykh Sred. K 100-Letiiu so Dnia Rozhdeniia Akademika V. G. Galerkina" Moscow, NAUKA, 1975 p 240-255
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

A study was made of the plasticity theory based on postulates of a mechanical nature with reference to small strains in initially isotropic materials. The working concepts of the theory are strictly defined and are uniquely reproducible in experiment. Construction of relations by using plastic strain does not yield any advantages. Author

N76-17429# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE SOLUTION OF PROBLEMS OF NONSTATIONARY ELASTIC WAVE DIFFRACTION BY CYLINDRICAL AND SPHERICAL OBSTACLES
V. D. Kubenko [1975] 5 p refs Transl. into ENGLISH from Dopovidi, AN UkrSSR, Ser. A, Fiz.-Mate. i Tekhn Nauk, (USSR), no. 10, 1975 p 901-906
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Consideration was given to the problem of a cylindrical body in an elastic medium when the case of the cylindrical cavity is examined. Specifically, the case of a rigid inclusion or a cylindrical shell soldered in an elastic medium was examined: the stress-strain state in the neighborhood of the cavity was determined. The problem was solved by reducing the inversion problem to the solution of Volterra integral equations of the first and second kind. Author

N76-17430# Army Construction Engineering Research Lab., Champaign, Ill.
TECHNICAL INFORMATION PAMPHLET ON FIBROUS CONCRETE OVERLAYS, FORT HOOD PROJECT Final Report
G. R. Williamson Aug. 1975 20 p refs
(DA Proj. 4A7-64717-D-895)
(AD-A015469; CERL-TR-M-147) Avail: NTIS CSCL 13/3

The first full-scale nonexperimental steel fibrqus concrete placement was completed in March 1974 at Fort Hood, Tex. An overlay of 3,175 cu yd of concrete was placed on a Tactical Equipment Park adjacent to Building 9529. The existing pavement consisted of 5 to 7 in. of asphaltic concrete on a stabilized limestone base. The area is a maintenance hardstand for M-60 tanks, M-88 tank retrievers, and other tracked vehicles. Because of the severe wear and rutting caused by the action of the tracks, the flexible pavement surface has required replacement every 3 to 4 yr. Fibrous concrete was selected as a more lasting solution to the problem. This report details the placement procedures used on the Fort Hood project and recommends other suitable techniques. Cost and preliminary performance evaluations of the Fort Hood overlay are presented. GRA

N76-17431# Oak Ridge National Lab., Tenn.
STRESS ANALYSES OF FLAT PLATES WITH ATTACHED NOZZLES: VOLUME 2: EXPERIMENTAL STRESS ANALYSES OF A FLAT PLATE WITH ONE NOZZLE ATTACHED
R. L. Battiste, W. H. Peters (Auburn Univ., Ala.), W. F. Ranson (Auburn Univ., Ala.), and W. F. Swinson (Auburn Univ., Ala.) Jul. 1975 124 p refs
(Contract W-7405-eng-26)
(ORNL-5044-Vol-2) Avail: NTIS HC $5.45

The complete test results are reported for a flat plate with one nozzle attached that was subjected to 1:1 and 1:2 biaxial planar loadings on the plate, to a thrust loading on the nozzle, and to a moment loading on the nozzle. The plate tested was 36 x 36 x 0.375 in., and the attached nozzle had an outer dia of 2.625 in. and a 0.250-in.-thick wall. The nozzle was located in the center of the plate and was considered to be free of weld distortions and irregularities in the junction area.
Author (NSA)

N76-17432# Oak Ridge Y-12 Plant, Tenn. Fabrication System Development Dept.
ANALYSIS OF STRESSES IN FILAMENT-WOUND SPHERICAL PRESSURE VESSELS PRODUCED BY THE DELTA-AXISYMMETRIC PATTERN
C. E. Knight, Jr. 8 Aug. 1975 82 p refs
(Contract W-7405-eng-26)
(Y-1972) Avail: NTIS HC $4.00

Spherical pressure vessels may be produced by filament winding the composite material with a delta axisymmetric pattern. This particular pattern yields a composite with high fiber density and efficient and reproducible structures. The pattern is readily defined mathematically and, thus, eases the analysis problem.
Author (NSA)

N76-17433# Watervliet Arsenal, N.Y.
STRAIN ENERGY RELEASE RATE FOR A CRACK UNDER COMPLEX LOADING
M. A. Hussain and S. L. Pu Jul. 1975 30 p refs
(AD-A014977; WVT-TR-75042) Avail: NTIS CSCL 11/6

This paper gives an expression for the energy release rate in an arbitrary direction for a crack subjected simultaneously to Mode I, Mode II and Mode III conditions. The energy release rate is computed using the elastic solution of a deflected crack, having a main branch and a propagation branch. The elastic solution for the anti-plane problem is easily obtained by use of complex variables. For the in-plane problem we use the limiting solution recently obtained. Using the critical energy release rate criterion, incipient paths of propagation as well as the fracture stresses of such a crack, were obtained from the maximum value of the energy release rate. Results are in close agreement with a few experimental results available in the literature. The energy release rate, in parametric form, can be used for any crack subjected to Modes I, II and III loading conditions.
Author (GRA)

N76-17434# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Materials Engineering.
THEORY OF STATIC FATIGUE IN BRITTLE SOLIDS. CRACKS AND ENERGY, CRITERIA FOR BRITTLE FRACTURE
R. H. Doremus Aug. 1975 43 p refs
(Contract N00014-67-A-0117-0014; NR Proj. 032-531)
(AD-A014669) Avail: NTIS CSCL 11/2

Two studies are included. In the first study, a theory of static fatigue in brittle solids is derived, based on the ideas of Hillig and Charles, but using a different log reaction velocity-stress relationship. The resulting equation agrees well with the functional dependence of failure time on stress found experimentally, and experimental values of the stress-sensitivity factor are

consistent with the theory. Variations in failure times with sample history and glass composition can only partly be explained by the theory. In the second study, energies of cracks are considered in terms of the first and second laws of thermodynamics, and it is concluded that the Griffith criterion provides a necessary but not sufficient condition for crack propagation. Thus surface energies calculated from fracture experiments give only an upper bound to the true surface energies of solids. The correct criterion for fracture is Inglis' equation for the stress at the tip of a crack; the radius of the crack tip is a parameter that cannot be ignored in fracture experiments. GRA

N76-17435# Frankford Arsenal, Philadelphia, Pa.
FINITE ELEMENT ANALYSIS OF A MULTI-COMPONENT KINETIC ENERGY PROJECTILE
Leonard M. Gold and Nancy A. Stowell Feb. 1975 21 p
(DA Proj. 1X5-64604-E-340)
(AD-A007805; FA-TM-75010) Avail: NTIS CSCL 19/1

Finite element techniques were used to perform a launch stress analysis on a multicomponent 27.5 mm kinetic energy projectile. The five parts of the projectile are analyzed separately using a layer of false boundary elements to determine the interaction between each component and those in contact with it. The stress history in the boundary elements was used as boundary conditions for the adjacent components. The analysis proceeds from the forward components toward the rear, providing the additive inertial load to each. Author (GRA)

N76-17436# Maryland Univ., College Park. Dept. of Aerospace Engineering.
PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON STRUCTURAL MECHANICS SOFTWARE, ADDENDUM Final Report, Jun. 1974 - Jun. 1975
Harry G. Schaeffer, Walter Pilkey, and Kenneth Saczalski Apr. 1975 300 p refs Symp. held at Coll. Park, Md., Jun. 1974 Prepared in cooperation with Va. Univ.
(Contracts N00014-69-A-0060-0009; N00014-67-A-0239-0028; Grant NSF GK-42324)
(AD-A014647; AE-75-3-Add) Avail: NTIS CSCL 13/13

The present volume contains papers and extended abstracts of papers that were presented at the International Symposium on Structural Mechanics Software and which were not included in the Symposium proceedings. Author (GRA)

N76-17437# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A COMPARISON OF THE WILLIAMS MODAL EXPANSION WITH THE CLASSICAL MODAL EXPANSION FOR SHOCK ANALYSIS COMPUTATIONS Final Report
S. R. Robertson Aug. 1975 24 p refs
(DA Proj. 1W1-62118-AH-75)
(AD-A015548; BRL-MR-2519) Avail: NTIS CSCL 20/11

A cantilever beam is subjected to uniformly distributed, smooth pulses of varying durations. The solution is obtained by Williams' method and the Classical Modal Expansion method. Approximations to the peak response are computed by the Biot and the Fung and Barton techniques. These techniques which were originally devised in conjunction with the Classical Modal Expansion method, are found not to be applicable when Williams' method is employed. GRA

N76-17438# Polytechnic Inst. of New York, Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics.
BUCKLING OF OVAL CYLINDRICAL SHELLS UNDER COMPRESSION AND UNSYMMETRIC BENDING Interim Report
Y. N. Chen and Joseph Kempner Jun. 1975 34 p refs
(Contract F44620-74-C-0047; AF Proj. 9782)
(AD-A015424; POLY-AE/AM-75-7; AFOSR-75-1425TR) Avail: NTIS CSCL 20/11

Bifurcation buckling of oval cylindrical shells under the interaction of uniform compressive forces and bending moments of arbitrary orientation is investigated. Buckling loads as well as the unsymmetric buckling modes are determined by a matrix interactive solution aided by a sequence of successive approximate solutions. GRA

N76-17439# Naval Postgraduate School, Monterey, Calif.
TRANSIENT THERMAL STRESS ANALYSIS OF COMPOSITE STRUCTURES INCLUDING CONTINUOUSLY VARYING PROPERTIES M.S. Thesis
Richard Bailey Bubeck Sep. 1975 345 p refs
(AD-A016572) Avail: NTIS CSCL 11/3

Calculations of transient thermal stress levels were made for composite coatings of hollow cylinders. Stress analysis was done during a thermal cycle of successive heating and cooling periods. Various coating configurations were investigated. The results showed the effect of changes in coating arrangements and the failure modes due to the excessive stress levels. Solutions were obtained by approximate techniques, and a computer program for transient three dimensional thermal stress analysis was developed. The finite element technique was employed for the determination of the temperature distribution and the elastic stress analysis. FORTRAN IV G Level was used as the programming language. GRA

N76-17440# New Mexico Univ., Albuquerque. Eric H. Wang Civil Engineering Research Facility.
FEASIBILITY STUDY ON DESIGN OF SELF-ERECTING AIRCRAFT SHELTER Final Report
Roy L. Johnson Oct. 1975 72 p refs
(Contract F29601-74-C-0030)
(AD-A016778; AFWL-TR-75-139) Avail: NTIS CSCL 15/5

This research examined the feasibility of designing and constructing an airtransportable, self-erecting aircraft shelter. Behavior of the shelter during erection and diserection was studied by field testing a 1/4-scale, segmented arch model of semicircular geometry, and by analyzing the behavior of a circular segmental prototype structure. Analyses of the structural behavior of the model and prototype were performed using the matrix-displacement method. Large displacements of the structure were accommodated analytically by use of a procedure of incremental displacement followed by an updating of structure geometry. A computer program (BOOTSTRAP) was developed to perform these analyses. Analyses showed that stable configurations of the 1/4-scale semicircular arch were achieved only when a single internal hinge was allowed in the structure. A satisfactory diserection procedure for the full-scale prototype was not achieved. GRA

N76-17441# National Bureau of Standards, Washington, D.C. Center for Building Technology.
THE BUFFETING OF TALL STRUCTURES BY STRONG WINDS Building Science Series
Emil Simiu and Daniel W. Lozier Oct. 1975 93 p refs
(COM-75-11442/1; NBS-BSS-74; LC-75-30727) Avail: NTIS HC $5.00 CSCL 13M

A procedure is presented for calculating alongwind response. The basic structural, meteorological and aerodynamic models employed are described, and expressions for the alongwind deflections and accelerations, consistent with those models, are derived. A computer program is presented for calculating the alongwind response of structures with unusual modal shapes or for which the contribution of the higher modes to the response is significant. GRA

N76-17442# Naval Research Lab., Washington, D.C.
PHOTOELASTIC ANALYSIS OF SHRINKAGE STRESSES AND ITS APPLICATION TO THE MICROMECHANICS OF COMPOSITES Final Report
Vincent J. Parks 12 Sep. 1975 22 p refs
(AD-A016880; NRL-7921) Avail: NTIS CSCL 20/11

A review of progress over the past 20 years in the development of photoelastic methods to determine the stresses and strains caused by restrained shrinkage in multimaterial bodies and in particular in composites demonstrates that the photoelastic method has been developed into a viable method for both two-dimensional and three-dimensional analysis of stresses caused by restrained shrinkage. The method has been used to solve a number of important problems and presumably will be used to solve more. Three-dimensional photoelasticity is generally applied to the microanalysis of shrinkage stresses in composite materials subjected to slow curing or slow thermal changes. Two-dimensional photoelastic analysis of composites is seen to be hampered by an inherent condition called pinching, which restricts

the analysis to regions away from the interfaces of the composite material. Author (GRA)

N76-17443# Cranfield Inst. of Technology (England). Dept. of Aircraft Design.
OPTIMUM DESIGN OF STIFFENED SHEAR WEBS WITH SUPPLEMENTARY SKIN STABILISATION Final Report, 1 Feb. 1974 - 31 Jan. 1975
D. M. Richards 25 Aug. 1975 28 p refs
(Grant AF-AFOSR-2693-74)
(AD-A015201; EOARD-TR-75-19; FR-1) Avail: NTIS CSCL 20/11

This report documents the result of an investigation of the optimum design of shear web structures whose function is to resist buckling. The structure considered was comprised of a simply supported thin metal web of constant depth, but infinite length, stabilized at uniform intervals by vertical stiffeners. The analysis was based on that of Stein and Fralich, and Cook and Rockey, and takes proper account of individual stiffener action in the buckling process and uses a realistic buckling mode between stiffeners. Results indicated that structural weight decreases continuously as stiffener spacing was reduced until an absolute minimum was achieved at a spacing well below practical limits. Computer routines based on the analysis have been written.
GRA

N76-17267 Stanford Univ., Calif.
MULTISTEP INTEGRATION METHODS FOR TRANSIENT PROBLEMS
M. Geradin *In* Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 7, No. 9 , Sep. 1975 p 3-20 refs
Presented at the Open Forum of the 1973 Western Appl. Mech. Conf., Menlo Park, Calif. (For availability see N76-17266 08-31)

42 GEOSCIENCES (GENERAL)

N76-17444*# Old Dominion Univ., Norfolk, Va.
THE EFFECT OF SHEARING STRAIN-RATE ON THE ULTIMATE SHEARING RESISTANCE OF CLAY Final Report
Robert Y. K. Cheng Feb. 1976 40 p refs
(Grant NGL-47-003-012)
(NASA-CR-2634) Avail: NTIS HC $4.00 CSCL 08M

The shearing resistance of cohesive soils subjected to a high rate of shearing strain was investigated. A fast step-loading torque apparatus was used to induce a state of pure shear in a hollow cylindrical soil specimen. The relationship between shearing resistance and rate of shear deformation was established for various soil densities expressed in terms of initial void ratio or water content. For rate of shearing deformation studies to date, the shearing resistance increases initially with shearing velocity but subsequently reaches a terminal value as the shearing velocity increases. The terminal shearing resistance is also found to increase as the density of the soil increases. The results are useful in the rheological study of clay. It is particularly important for mobility problems of soil runways, since the soil resistance is found to be sensitive to the rate of shearing. Author

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography*.

N76-17445*+ National Aeronautics and Space Administration, Washington, D.C.
EARTH RESOURCES: A CONTINUING BIBLIOGRAPHY WITH INDEXES, ISSUE 5, OCTOBER 1975
Oct. 1975 151 p
(NASA-SP-7041(05)) Avail: NTIS HC $4.00 (special price) CSCL 05B

This bibliography lists 601 reports, articles, and other documents introduced into the NASA scientific and technical information system between January 1975 and March 1975. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis. Author

N76-17446*# Norwegian Water Resources and Electricity Board, Oslo.
HYDROLOGICAL INVESTIGATIONS IN NORWAY Quarterly Report, 1 Aug. - 1 Nov. 1975
Helge A. Odegaard, Principal Investigator 1 Nov. 1975 4 p
Sponsored by NASA ERTS
(E76-10137; NASA-CR-146146) Avail: NTIS HC $3.50 CSCL 08H

There are no author-identified significant results in this report.

N76-17447*# Ecole Practique des Hautes Etudes, Paris (France).
THE FRENCH ATLANTIC LITTORAL AND THE MASSIF ARMORICAIN Progress Report, Sep. - Dec. 1975
Fernand Verger, Principal Investigator and Jean-Marie Monget Dec. 1975 7 p refs Sponsored by NASA and CNES ERTS
(E76-10138; NASA-CR-146147; Rept-1) Avail: NTIS HC $3.50 CSCL 08F

There are no author-identified significant results in this report.

N76-17448*# Servicio Geologico de Bolivia, La Paz.
EARTH RESOURCE TECHNOLOGY SATELLITE (ERTS-A) SENSOR DATA FOR MINERAL RESOURCE SECTOR DEVELOPMENT AND USE SURVEY Progress Report, Jul. - Oct. 1975
Carlos E. Brockman, Principal Investigator Oct. 1975 11 p
Sponsored by NASA ERTS
(E76-10139; NASA-CR-146148) Avail: NTIS HC $3.50 CSCL 08G

There are no author-identified significant results in this report.

N76-17449*# Minnesota State Planning Agency, St. Paul.
ANALYSIS OF DATA FOR LANDSAT (ERTS) FOLLOW-ON Progress Report, 26 Sep. - 25 Dec. 1975
Joseph E. Sizer, Principal Investigator 26 Jan. 1976 18 p refs ERTS
(Contract NAS5-20985)
(E76-10140; NASA-CR-146149) Avail: NTIS HC $3.50 CSCL 05B

The author has identified the following significant results. Daily weather service satellite photographs of the midwest were found to be of great assistance before ordering EROS Data Center products. These weather satellite images are a quick and inexpensive record of the location of cloud masses, which supplements the percent of cloud catalogues. Savings of time and money were made because the location of cloud cover was known before any imagery was ordered.

N76-17450*# New Mexico State Bureau of Mines and Mineral Resources, Socorro.
EARTH RESOURCES EVALUATION FOR NEW MEXICO BY LANDSAT-2 Progress Report, 1 Sep. - 30 Nov. 1975
David E. Tabet, Principal Investigator, Frank E. Kottlowski, Michael H. Inglis, Linda L. Love, and Stanley A. Morain 30 Nov. 1975 5 p refs ERTS
(Contract NAS5-20916)
(E76-10141; NASA-CR-146150) Avail: NTIS HC $3.50 CSCL 08B

There are no author-identified significant results in this report.

N76-17451*# Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.

APPLICATION OF LANDSAT DATA TO DELIMITATION OF AVALANCHE HAZARDS IN MONTANE, COLORADO Interim Report, Sep. - Dec. 1975
Daniel H. Knepper, Principal Investigator, J. D. Ives, and R. Summer Jan. 1976 20 p refs ERTS
(Contract NAS5-20914)
(E76-10142; NASA-CR-146151) Avail: NTIS HC $3.50 CSCL 08F

The author has identified the following significant results. Photointerpretation of individual avalanche paths on single band black and white LANDSAT images is greatly hindered by terrain shadows and the low spatial resolution of the LANDSAT system. Maps produced in this way are biased towards the larger avalanche paths that are under the most favorable illumination conditions during imaging; other large avalanche paths, under less favorable illumination, are often not detectable and the smaller paths, even those defined by sharp trimlines, are only rarely identifiable.

N76-17452*# Geological Survey, Reston, Va.
DETECTION AND MAPPING OF MINERALIZED AREAS IN THE CORTEZ-UINTA BELT, UTAH-NEVADA, USING COMPUTER-ENHANCED ERTS IMAGERY Progress Report
Lawrence C. Rowan, Principal Investigator 15 Jan. 1976 6 p ref ERTS
(E76-10143; NASA-CR-146152) Avail: NTIS HC $3.50 CSCL 08B

The author has identified the following significant results. Preliminary analysis indicates that mineralogical differences between altered rocks and most unaltered rocks in south-central Nevada cause visible and near infrared spectral reflectance differences, which can be used to discriminate these broad categories of rocks in multispectral images. The most important mineralogical differences are the increased abundance of goethite, hematite, and jarosite, and the presence of alunite, montmorillonite, and kaolinite in the altered rock. The technique to enhance subtle spectral differences combines ratioing of the MSS bands and contrast stretching. The stretched ratio values are used to produce black and white images that depict materials according to spectral reflectance; rationing minimizes the influence of topography and overall albedo on the grouping of spectrally similar materials. Field evaluation of color-ratio composite shows that, excluding alluvial areas, approximately 80 percent of the green and brown color patterns are related to hydrothermal alternation. The remaining 20 percent consists mainly of pink hematitic crystallized tuff, a result of vapor phase crystallization, and of tan and red ferruginous shale and siltstone.

N76-17453*# South Dakota State Univ., Brookings. Remote Sensing Inst.
BOUNDARY-DETECTION ALGORITHM FOR LOCATING EDGES IN DIGITAL IMAGERY
V. I. Myers, Principal Investigator, M. J. Russell, D. G. Moore, and G. D. Nelson Apr. 1975 32 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-13337)
(E76-10144; NASA-CR-146153; RSI-SDSU-74-10) Avail: NTIS HC $4.00 CSCL 08M

The author has identified the following significant results. Initial development of a computer program which implements a boundary detection algorithm to detect edges in digital images is described. An evaluation of the boundary detection algorithm was conducted to locate boundaries of lakes from LANDSAT-1 imagery. The accuracy of the boundary detection algorithm was determined by comparing the area within boundaries of lakes located using digitized LANDSAT imagery with the area of the same lakes planimetered from imagery collected from an aircraft platform.

N76-17454*# Purdue Univ., Lafayette, Ind.
CROP IDENTIFICATION AND ACREAGE ESTIMATION OVER LARGE GEOGRAPHIC AREAS USING LANDSAT MSS DATA Quarterly Progress Report, 1 Oct. - 31 Dec. 1975
Marvin E. Bauer, Principal Investigator 31 Dec. 1975 5 p ref ERTS
(Contract NAS5-20793)
(E76-10145; NASA-CR-146154) Avail: NTIS HC $3.50 CSCL 02C

There are no author-identified significant results in this report.

N76-17455*# Tokai Univ., Shizuoka (Japan).
STUDY OF SEA ICE IN THE SEA OF OKHOTSK AND ITS INFLUENCE ON THE OYASHIO CURRENT Final Report
Kantaro Watanabe, Ryuya Kuroda (Tohoku Regional Fisheries Res. Lab.), Katsumi Hata (Japan Meteorological Agency), and Masaomi Akagawa, Principal Investigators (Hakodate Marine Observatory) 26 Dec. 1975 29 p refs Sponsored by NASA and Sci. and Technol. Agency, Japan Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E76-10146; NASA-CR-144472) Avail: NTIS HC $4.00 CSCL 08L

The author has identified the following significant results. Two photographic techniques were applied to Skylab S190A multispectral pictures for extracting oceanic patterns at the sea surface separately from cloud patterns. One is the image-masking technique and another a stereographic analysis. The extracted oceanic patterns were interpreted as areas where the amount, or the concentration of phytoplankton was high by utilizing surface data of water temperature, ocean current by GEK, and microplankton.

N76-17456*# Science Applications, Inc., La Jolla, Calif.
DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM LANDSAT DATA Progress Report, 1 Nov. 1975 - 31 Jan. 1976
M. Griggs, Principal Investigator 1 Feb. 1976 20 p ERTS
(Contract NAS5-20899)
(E76-10147; NASA-CR-146156; SAI-76-518-LJ; PR-4) Avail: NTIS HC $3.50 CSCL 04B

There are no author-identified significant results in this report.

N76-17457*# Ohio Dept. of Economic and Community Development, Columbus.
DEVELOPMENT OF A MULTI-DISCIPLINARY ERTS USER PROGRAM IN THE STATE OF OHIO Quarterly Progress Report
Paul E. Baldridge, Principal Investigator 10 Dec. 1975 4 p ERTS
(Contract NAS5-22399)
(E76-10148; NASA-CR-146157; QPR-2) Avail: NTIS HC $3.50 CSCL 05B

There are no author-identified significant results in this report.

N76-17458*# Delaware Univ., Newark. Coll. of Marine Studies.
APPLICATION OF LANDSAT-2 TO THE MANAGEMENT OF DELAWARE'S MARINE AND WETLAND RESOURCES Progress Report, Nov. 1975 - Jan. 1976
V. Klemas, Principal Investigator, D. Bartlett, W. Philpot, and G. Davis 9 Feb. 1976 8 p refs ERTS
(Contract NAS5-20983)
(E76-10149; NASA-CR-146158) Avail: NTIS HC $3.50 CSCL 08A

The author has identified the following significant results. The spectral signature of the acid waste disposal plume investigated 38 miles off the Delaware coast, is caused primarily by scattering from particles in the form of suspended ferric iron floc. In comparison, the absorption caused by the dissolved fraction of iron and other substances has a negligible effect on the spectral signature. Ocean waste disposal plumes were observed by LANDSAT-1 and -2 during dump up to 54 hours afer dump during fourteen different passes over the Delaware test site. The spatial resolution, radiometric sensitivity, and spectral band location of the LANDSAT multispectral scanner are sufficient to identify the location of ocean disposal plumes. The movement and dispersion of ocean waste disposal plumes can be estimated if the original dump location, time, and injection method are known. Operating LANDSAT in the high gain mode helps to determine plume dispersion more accurately.

N76-17459*# Earth Satellite Corp., Washington, D.C.
APPLICATION OF LANDSAT-2 DATA TO THE IMPLEMENTATION AND ENFORCEMENT OF THE PENNSYLVANIA SURFACE MINING CONSERVATION AND RECLAMATION ACT Progress Report, 19 Sep. - 19 Dec. 1975
Daniel J. Deely, Principal Investigator 19 Dec. 1975 10 p ERTS
(Contract NAS5-21998)
(E76-10150; NASA-CR-146159; C-1037-2-3) Avail: NTIS HC $3.50 CSCL 08I

There are no author-identified significant results in this report.

N76-17460*# Kansas Univ., Lawrence. Space Technology Center.
SKYLAB STUDY OF WATER QUALITY Final Report, 23 Feb. - 31 Jul. 1975
Harold L. Yarger, Principal Investigator and James R. McCauley 31 Jul. 1975 39 p refs EREP
(Contract NAS9-13271)
(E76-10151; NASA-CR-144505) Avail: NTIS HC $4.00

The author has identified the following significant results. Apparent reflectance levels in the Skylab S190A and S192 bands, from one pass over three Kansas reservoirs, exhibit good statistical correlation with suspended solids. Band ratios appear to yield the best results. The concentration of suspended solids, mostly inorganic sediment, has the most effect on the reflected energy. Dissolved solids concentrations up to 200 ppm were not detectable by the Skylab sensors.

N76-17461*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
ANALYSIS OF RECREATIONAL LAND USING SKYLAB DATA Final Report, 7 May 1973 - 15 Sep. 1975
I. J. Sattinger, Principal Investigator, F. G. Sadowski, and N. E. G. Roller Jan. 1976 80 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-13283)
(E76-10152; NASA-CR-144471; ERIM-103300-58-F) Avail: NTIS HC $5.00 CSCL 08B

The author has identified the following significant results. S192 data collected on 5 August 1973 were processed by computer to produce a classification map of a part of the Gratiot-Saginaw State Game Area in south central Michigan. A 10-category map was prepared of an area consisting of diverse terrain types, including forests, wetlands, brush, and herbaceous vegetation. An accuracy check indicated that 54% of the pixels were correctly recognized. When these ten scene classes were consolidated to a 5-category map, the accuracy increased to 72%. S190 A, S190 B, and S192 data can be used for regional surveys of existing and potential recreation sites, for delineation of open space, and for preliminary evaluation of geographically extensive sites.

N76-17462*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
ASSESSMENT OF MAPPING EXPOSED FERROUS AND FERRIC IRON COMPOUNDS USING SKYLAB-EREP DATA Final Report, 8 Mar. 1973 - 30 Aug. 1975
R. Vincent, Principal Investigator, H. Wagner, W. Pillars, and C. Bennett Jan. 1976 65 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-13317)
(E76-10153; NASA-CR-144504; ERIM-102000-42-F) Avail: NTIS HC $4.50 CSCL 08G

The author has identified the following significant results. The S190B color photography is as useful as LANDSAT data for the mapping of color differences in the rocks and soils of the terrain. An S192 ratio of 0.79 - 0.89 and 0.93 - 1.05 micron bands produced an apparently successful delineation of ferrous, ferric, and other materials, in agreement with theory and ratio code studies. From an analysis of S191 data, basalt and dacite were separated on the basis of differences in spectral emissivity in the 8.3 - 12 micron region.

N76-17463*# Environmental Research and Technology, Inc., Concord, Mass.
EXPERIMENTAL EVALUATION OF ATMOSPHERIC EFFECTS ON RADIOMETRIC MEASUREMENTS USING THE EREP OF SKYLAB Final Report
David T. Chang, Principal Investigator and Ronald G. Isaacs Dec. 1975 93 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-13343)
(E76-10154; NASA-CR-144500; ERT-0410-F) Avail: NTIS HC $5.00 CSCL 20F

The author has identified the following significant results. Test sites were located near the Great Salt Lake and the Salton Sea. Calculations were performed for a set of atmospheric models corresponding to the test sites, in addition to standard models for summer and winter midlatitude atmospheres with respective integrated water vapor amount of 2.4 g/sq cm and 0.9 g/sq cm. Each atmosphere was found to contain an average amount of continental aerosol. Computations were valid for high solar elevation angles. Atmospheric attenuation quantities were computed in addition to simulated EREP S192 radiances.

N76-17464*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
SKYLAB IMAGERY: APPLICATION TO RESERVOIR MANAGEMENT IN NEW ENGLAND Final Report
Saul Cooper (Corp of Engineers, Waltham, Mass.), Duwayne Anderson, Principal Investigators, H. L. McKim, L. W. Gatto, C. J. Merry, and R. K. Haugen Sep. 1975 60 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP
(NASA Order T-4646-B)
(E76-10155; NASA-CR-144514) Avail: NTIS HC $4.50 CSCL 08H

The author has identified the following significant results. S190B imagery is superior to the LANDSAT imagery for land use mapping and is as useful for level 1 and 2 land use mapping as the RB-57/RC8 high altitude imagery. Detailed land use mapping at levels 3 and finer from satellite imagery requires better resolution. For evaluating factors that are required to determine volume runoff potentials in a watershed, the S190B imagery was found to be as useful as the RB-57/RC8 high altitude aircraft imagery.

N76-17465*# National Space Development Agency, Tokyo (Japan).
THE STUDY OF MESOSCALE PHENOMENA, WINTER MONSOON CLOUDS AND SNOW AREA Final Report
Kiyoshi Tsuchiya, Principal Investigator 25 Dec. 1975 18 p refs Sponsored by NASA and Sci. and Technol. Agency, Japan Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E76-10156; NASA-CR-144469) Avail: NTIS HC $3.50 CSCL 04B

The author has identified the following significant results. The clouds under a moderate winter monsoon situation taken with S190A camera reveal existence of clouds with band structure of various wavelengths. The wavelength ranges from 0.4 to 3.5 kms. There was a good relationship between the longitudinal cloud band and vertical wind shear. There was a distinct difference in size of clouds between the Japan Sea side or upwind side and the Pacific Ocean side or downwind side of the Japanese mainland. Large solid cumulus clusters have the size of 20 x 35 sq km over the Japan Sea off the coast of Hokuriku District. It was found that S190A aerial color pictures showing shadows of fair weather cumuli over the sea could be successfully used in estimating cloud height while S190A station 1 picture was more useful over the land since it could more clearly distinguish shadow from vegetation. The height of fair weather cumuli estimated from shadows agree with the lifted condensation level. It was also found that these pictures were effectively used in delineating snow cover area. S192 data, especially IR channel, were found to be effective in finding topography of nimbostratus.

N76-17466*# Science Univ. of Tokyo (Japan).
INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN Final Report
Takakazu Maruyasu, Hiroaki Ochiai, and Takamasa Nakano, Principal Investigators 18 Dec. 1975 29 p refs Sponsored by NASA and Sci. and Technol. Agency, Japan Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E76-10157; NASA-CR-144569) Avail: NTIS HC $4.00 CSCL 14B

There are no author-identified significant results in this report.

N76-17467*# Arizona Univ., Tucson. School of Renewable Natural Resources.
SOUTHERN ARIZONA RIPARIAN HABITAT: SPATIAL DISTRIBUTION AND ANALYSIS
John R. Lacey, Phil R. Ogden, and Kennith E. Foster Aug. 1975 157 p refs Sponsored in part by Natl. Resources Comm., Ariz. State Senate
(Grant NGL-03-002-313)
(NASA-CR-146415; OALS-Bull-8) Avail: NTIS HC $6.75 CSCL 08F

The objectives of this study were centered around the demonstration of remote sensing as an inventory tool and researching the multiple uses of riparian vegetation. Specific study objectives were to: (1) map riparian vegetation along the Gila River, San Simon Creek, San Pedro River, Pantano Wash, (2) determine the feasibility of automated mapping using LANDSAT-1 computer compatible tapes, (3) locate and summarize existing mpas delineating riparian vegetation, (4) summarize data relevant to Southern Arizona's riparian products and uses, (5) document recent riparian vegetation changes along a selected portion of the San Pedro River, (6) summarize historical changes in composition and distribution of riparian vegetation, and (7) summarize sources of available photography pertinent to Southern Arizona. Author

N76-17468*# Michigan State Univ., East Lansing.
USE OF REMOTE SENSING FOR LAND USE POLICY FORMULATION Annual Progress Report, Jun. 1974 - May 1975
Myles Boylan and Raymond D. Vlasin 13 Jan. 1976 32 p refs
(Grant NGL-23-004-083)
(NASA-CR-146399) Avail: NTIS HC $4.00 CSCL 08B

Uses of remote sensing imagery were investigated based on exploring and evaluating the capability and reliability of all kinds of imagery for improving decision making on issues of land use at all scales of governmental administration. Emphasis was placed on applications to solving immediate problems confronting public agencies and private organizations. Resulting applications of remote sensing use by public agencies, public organizations, and related private corporations are described. Author

N76-17469*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 1-A: AGRICULTURE, ENVIRONMENT First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data
Jun. 1975 600 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-B N76-17501; Vol. 1-C N76-17552; Vol. 1-D N76-17588; Vol. 3 N76-17613; Original contains color imagery. Original NASA photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(NASA-TM-X-58168-Vol-1-A; JSC-09930-Vol-1-A) Avail: NTIS HC $7.25 CSCL 05B

A number of papers dealing with the practical application of imagery obtained from remote sensors on LANDSAT satellites, the Skylab Earth resources experiment package, and aircraft to problems in agriculture and the environment were presented. Some of the more important topics that were covered included: range management and resources, environmental monitoring and management, crop growth and inventory, land management, multispectral band scanners, forest management, mapping, marshlands, strip mining, water quality and pollution, ecology. For individual titles, see N76-17470 through N76-17500.

N76-17470* Nebraska Univ., Lincoln. Conservation and Survey Div.
ESTIMATING VEGETATIVE BIOMASS FROM LANDSAT-1 IMAGERY FOR RANGE MANAGEMENT
Paul M. Seevers, James V. Drew, and Marvin P. Carlson *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 1-8 refs (For availability see N76-17469 08-43)
(A-1) CSCL 08F

Evaluation of LANDSAT-1, band 5 data for use in estimation of vegetative biomass for range management decisions was carried out for five selected range sites in the Sandhills region of Nebraska. Analysis of sets of optical density-vegetative biomass data indicated that comparisons of biomass estimation could be made within one frame but not between frames without correction factors. There was high correlation among sites within sets of radiance value-vegetative biomass data and also between sets, indicating comparisons of biomass could be made within and between frames. Landsat-1 data are shown to be a viable alternative to currently used methods of determining vegetative biomass production and stocking rate recommendations for Sandhills rangeland. Author

N76-17471* Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
DISCRIMINATING COASTAL RANGELAND PRODUCTION AND IMPROVEMENTS WITH COMPUTER AIDED TECHNIQUES
C. A. Reeves and D. P. Faulkner *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 9-17 refs (For availability see N76-17469 08-43)
(A-2) CSCL 08B

The feasibility and utility of using satellite data and computer-aided remote sensing analysis techniques to conduct range inventories were tested. This pilot study was focused over a 250,000 acre site in Galveston and Brazoria Counties along the Texas Gulf Coast. Rectified enlarged aircraft color infrared photographs of this site were used as the ground truth base. The different land categories were identified, delineated, and measured. Multispectral scanner (MSS) bulk data from LANDSAT-1 was received and analyzed with the Image 100 pattern recognition system. Features of interest were delineated on the image console giving the number of picture elements classified; the picture elements were converted to acreages and the accuracy of the technique was evaluated by comparison with data base results for three test sites. The accuracies for computer aided classification of coastal marshes ranged from 89% to 96%. Y.J.A.

N76-17472* California Univ., Berkeley.
USEFULNESS OF LANDSAT DATA FOR MONITORING PLANT DEVELOPMENT AND RANGE CONDITIONS IN CALIFORNIA'S ANNUAL GRASSLAND
David M. Carneggie (EROS Data Center, Sioux Falls, S.D.), Stephen D. DeGloria, and Robert N. Colwell *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 19-41 refs (For availability see N76-17469 08-43)
(A-3) CSCL 08F

A network of sampling sites throughout the annual grassland region of California was established to correlate plant growth stages and forage production to climatic and other environmental factors. Plant growth and range conditions were further related to geographic location and seasonal variations. A sequence of LANDSAT data was obtained covering critical periods in the growth cycle. This was analyzed by both photointerpretation and computer aided techniques. Image characteristics and spectral reflectance data were then related to forage production, range condition, range site and changing growth conditions. It was determined that repeat sequences with LANDSAT color composite images do provide a means for monitoring changes in range condition. Spectral radiance data obtained from magnetic tape can be used to determine quantitatively the critical stages in

the forage growth cycle. A computer ratioing technique provided a sensitive indicator of changes in growth stages and an indication of the relative differences in forage production between range sites. Author

N76-17473* Texas A&M Univ., College Station.
MONITORING VEGETATION CONDITIONS FROM LANDSAT FOR USE IN RANGE MANAGEMENT
R. H. Haas, D. W. Deering, J. W. Rouse, Jr., and J. A. Schell *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 43-52 (For availability see N76-17469 08-43)
(A-4) CSCL 08F

A summary of the LANDSAT Great Plains Corridor projects and the principal results are presented. Emphasis is given to the use of satellite acquired phenological data for range management and agri-business activities. A convenient method of reducing LANDSAT MSS data to provide quantitative estimates of green biomass on rangelands in the Great Plains is explained. Suggestions for the use of this approach for evaluating range feed conditions are presented. A LANDSAT Follow-on project has been initiated which will employ the green biomass estimation method in a quasi-operational monitoring of range readiness and range feed conditions on a regional scale. Author

N76-17474* Kansas Univ., Lawrence. Space Technology Center.
UTILIZATION OF LANDSAT IMAGERY FOR MAPPING VEGETATION ON THE MILLIONTH SCALE
Donald L. Williams and Jerry C. Coiner *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 53-65 refs (For availability see N76-17469 08-43)
(Grant NGL-17-004-024)
(A-5) CSCL 08F

A series of test sites were examined to determine if the information content of the LANDSAT imagery that may be obtained of these sites is sufficient to permit their mapping according to the vegetation classification system recently published by Unesco. These sites include examples from the humid tropics, arid and semi-arid subtropics and temperature zones: Western Highlands of Papua New Guinea, Mindoro Island in the Philippines, Great Smoky Mountains of the southeastern United States, East Tennessee Valley, interior of Western Australia, northeastern Uganda, and south-central Kansas. The results of the experiment were presented in the form of vegetation maps and annotated images which serve to illustrate the detectability of various formations. It was concluded that, for the test sites examined, the formations of the Unesco vegetation classification can be satisfactorily distinguished on LANDSAT MSS images, especially when used as color composites and judiciously chosen as to season. Author

N76-17475* South Dakota State Univ., Brookings. Plant Science Dept.
LANDSAT-1 DATA, ITS USE IN A SOIL SURVEY PROGRAM
F. C. Westin and C. J. Frazee *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 67-95 refs (For availability see N76-17469 08-43)
(A-6) CSCL 08M

The following applications of LANDSAT imagery were investigated: assistance in recognizing soil survey boundaries, low intensity soil surveys, and preparation of a base map for publishing thematic soils maps. The following characteristics of LANDSAT imagery were tested as they apply to the recognition of soil boundaries in South Dakota and western Minnesota: synoptic views due to the large areas covered, near-orthography and lack of distortion, flexibility of selecting the proper season, data recording in four parts of the spectrum, and the use of computer compatible tapes. A low intensity soil survey of Pennington County, South Dakota was completed in 1974. Low intensity inexpensive soil surveys can provide the data needed to evaluate agricultural land for the remaining counties until detailed soil surveys are completed. In using LANDSAT imagery as a base map for publishing thematic soil maps, the first step was to prepare a mosaic with 20 LANDSAT scenes from several late spring passes in 1973. Author

N76-17476* Purdue Univ., Lafayette, Ind.
DELINEATION OF THE BOUNDARIES OF A BURIED PRE-GLACIAL VALLEY WITH LANDSAT-1 DATA
J. B. Peterson, F. E. Goodrick, and W. N. Melhorn *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 97-103 refs (For availability see N76-17469 08-43)
(A-7) CSCL 08B

The continuity of a narrow meandering strip of Udoll (prairie) soils running east and west for approximately 40 miles across north central Indiana in an area predominantly of Udalfs (timber soils) was detected from LANDSAT-1 data taken on June 9, 1973. This data was processed through a clustering procedure and classified with resulting increased definition of the boundaries among soils grouped according to nine categories and vegetation to two categories of reflectance. This dark stretch of prairie soil is believed to have formed in the heavy textured, poorly drained glacial debris which filled a major pre-glacial tributary of the Teays River System. Ready identification and location of the valley has significance to soil survey and land classification people as a guide to soil classification and land use and to geologists as a guide to location of a potentially economically significant aquifer. Author

N76-17477* Canadian Forestry Service, Victoria (British Columbia). Pacific Forest Research Centre.
ARE CLEAR-CUT AREAS ESTIMATED FROM LANDSAT IMAGERY RELIABLE?
Y. Jim Lee *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 105-114 refs (For availability see N76-17469 08-43)
(A-8) CSCL 08B

The reliability of LANDSAT imagery for estimation of clear-cut areas was evaluated by comparison with data obtained from high-altitude photos and logging historical map and from field inspections. A mature forest was selected as a test site because of its continuous clear-cut operation. The forest is about 50 km northwest of Victoria, British Columbia, Canada, and consists of 9092 ha. Areas clear-cut within the past year were overestimated by 12.9%, those clear-cut 1-year or more by 2.2%, whereas uncut mature timber was underestimated by 3.6%. Three clear-cut areas were missed in the logging map and two in the LANDSAT enhancement. The difference between area estimates was significant when all 26 areas were included but not when 2 overestimated areas were excluded from the analysis. The study indicates that LANDSAT imagery color enhancement is a useful tool in up-dating clear-cut areas for long-term planning in forest management. Author

N76-17478* Saint Regis Paper Co., Jacksonville, Fla. Southern Timberlands Div.
OPERATIONAL CONSIDERATIONS FOR THE APPLICATION OF REMOTELY SENSED FOREST DATA FROM LANDSAT OR OTHER AIRBORNE PLATFORMS
G. Robinson Baker and Terrance P. Fethe *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 115-133 refs (For availability see N76-17469 08-43)
(A-10) CSCL 02F

Research in the application of remotely sensed data from LANDSAT or other airborne platforms to the efficient management of a large timber based forest industry was divided into three phases: (1) establishment of a photo/ground sample correlation, (2) investigation of techniques for multi-spectral digital analysis, and (3) development of a semi-automated multi-level sampling system. To properly verify results, three distinct test areas were selected: (1) Jacksonville Mill Region, Lower Coastal Plain, Flatwoods, (2) Pensacola Mill Region, Middle Coastal Plain, and (3) Mississippi Mill Region, Middle Coastal Plain. The following conclusions were reached: (1) the probability of establishing an information base suitable for management requirements through a photo/ground double sampling procedure, alleviating the ground sampling effort, is encouraging, (2) known classification techniques must be investigated to ascertain the level of precision possible

in separating the many densities involved, and (3) the multi-level approach must be related to an information system that is executable and feasible. Author

N76-17479* Lockheed Electronics Co., Houston, Tex.
TIMBER TYPE SEPARABILITY IN SOUTHEASTERN UNITED STATES ON LANDSAT-1 MSS DATA
E. P. Kan and R. D. Dillman *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 135-157 refs (For availability see N76-17469 08-43)
(Contract NAS9-12200)
(A-11) CSCL 02F

A quantitative, computer-aided study was made on the spectral separability of timber types and condition classes in the Southeastern United States, using LANDSAT-1 multispectral scanner data. It was concluded that LANDSAT-1 could be used effectively to discriminate the gross forest features of softwood, hardwood, and regeneration. The only significant detectable age difference would be between an established forest versus a young (or denuded) forest. The red or near infrared bands would be better for discrimination; phenological early and late spring data would be better than winter. And a temporal analysis would be superior to single-season analysis. Lastly, two spectral bands would be most cost effective for computer analysis. The study site was Sam Houston National Forest of East Texas, a typical forest in the Flatwoods Zone, Southern Region, U. S. Forest Service. Author

N76-17480* California Univ., Berkeley.
MAPPING OF THE WILDLAND FUEL CHARACTERISTICS OF THE SANTA MONICA MOUNTAINS OF SOUTHERN CALIFORNIA
J. D. Nichols *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 159-166 (For availability see N76-17469 08-43)
(A-12) CSCL 08B

LANDSAT digital data was successfully used to map and evaluate the wildland fuels of the Santa Monica Mountains in Southern California. A mixed classification scheme was used where training areas of known vegetation types were entered and the maximum likelihood classifier run, followed by an evaluation of the results and an unsupervised retraining of the classifier using an image of the probability of misclassification. Estimation of maturity class and crown closure percents of the major cover types were assigned to each computer class by associating the photointerpretation of 159 large scale photo samples with the resultant computer classes using analysis of variance and analysis of categorized data. The result of the computer classification and statistical analysis were then transformed from the LANDSAT Coordinate California State Plane Coordinate system for use in a digital format in the FIRESCOPE data retrieval and fire modeling system. Author

N76-17481* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPUTER ANALYSIS AND MAPPING OF GYPSY MOTH LEVELS IN PENNSYLVANIA USING LANDSAT-1 DIGITAL DATA
Darrel L. Williams *In its* NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 167-181 refs Sponsored in part by McIntire-Stennis Fund and Pennsylvania State Univ. (For availability see N76-17469 08-43)
(A-13) CSCL 02F

The effectiveness of using LANDSAT-1 multispectral digital data and imagery, supplemented by ground truth and aerial photography, was investigated as a new method of surveying gypsy moth (Porthetria dispar (L.)) (Lepidoptera; Lymantriidae) defoliation, which has greatly increased in Pennsylvania in recent years. Since the acreage and severity of gypsy moth defoliation reaches a peak from mid-June through the first few days of July, the July 8, 1973, LANDSAT-1 scene was chosen for analysis. Results indicate that LANDSAT-1 data can be used to discriminate between defoliated and healthy vegetation in Pennsylvania and that digital processing methods can be used to map the extent and degree of defoliation. Author

N76-17482* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
COMPUTER IMPLEMENTED CLASSIFICATION OF VEGETATION USING AIRCRAFT ACQUIRED MULTISPECTRAL SCANNER DATA
William G. Cibula *In its* NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 183-201 refs (For availability see N76-17469 08-43)
(A-14) CSCL 08F

The use of aircraft 24-channel multispectral scanner data in conjunction with computer processing techniques to obtain an automated classification of plant species association was discussed. The classification of various plant species associations was related to information needed for specific applications. In addition, the necessity for multiple selection of training fields for a single class in situations where the study area consists of highly irregular terrain was detailed. A single classification was illuminated differently in different areas, resulting in the existence of multiple spectral signatures for a given class. These different signatures result since different qualities of radiation upwell to the detector from portions that have differing qualities of incident radiation. Techniques of training field selection were outlined, and a classification obtained from a natural area in Tishomingo State Park in northern Mississippi was presented. Author

N76-17483* Agricultural Research Service, Weslaco, Tex. Southern Region Citrus Insects Research.
THE USE OF SKYLAB DATA TO STUDY THE EARLY DETECTION OF INSECT INFESTATIONS AND DENSITY AND DISTRIBUTION OF HOST PLANTS
W. G. Hart, S. J. Ingle, and M. R. Davis *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr. Environment Jun. 1975 p 203-219 refs (For availability see N76-17469 08-43)
(A-15) CSCL 08C

The detection of insect infestations and the density and distribution of host plants were studied using Skylab data, aerial photography and ground truth simultaneously. Additional ground truth and aerial photography were acquired between Skylab passes. Three test areas were selected: area 1, of high density citrus, was located northwest of Mission, Texas; area 2, 20 miles north of Weslaco, Texas, irrigated pastures and brush-covered land; area 3 covered the entire Lower Rio Grande Valley and adjacent areas of Mexico. A color composite picture of S-190A data showed patterns of vegetation on both sides of the Rio Grande River clearly delineating the possible avenues of entry of pest insects from Mexico into the United States or from the United States into Mexico. Vegetation that could be identified with conventional color and color IR film included: citrus, brush, sugarcane, alfalfa, irrigated and unimproved pastures. Author

N76-17484* General Electric Co., Beltsville, Md. Space Systems Organization.
AGRICULTURAL INVENTORY CAPABILITIES OF MACHINE PROCESSED LANDSAT DIGITAL DATA
David L. Dietrick, Ronald E. Fries, and Dwight D. Egbert *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 221-232 refs (For availability see N76-17469 08-43)
(A-16) CSCL 02C

Agricultural crop identification and acreage determination analysis of LANDSAT digital data was performed for two study areas. A multispectral image processing and analysis system was utilized to perform the manmachine interactive analysis. The developed techniques yielded crop acreage estimate results with accuracy greater than 90% and as high as 99%. These results are encouraging evidence of agricultural inventory capabilities of machine processed LANDSAT digital data. Author

N76-17485* General Electric Co., Beltsville, Md.
AGRICULTURAL APPLICATIONS OF REMOTE SENSING: A TRUE LIFE ADVENTURE
Earle S. Schaller *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 233-238 (For availability see N76-17469 08-43)
(A-17) CSCL 02C

A study of agricultural applications of remote sensing with a major US agricultural firm was undertaken in mid-1973. The

study continued for eighteen months, and covered the areas of crop monitoring and management as well as large scale crop inventories. Pilot programs in the application of aircraft remote sensing and LANDSAT data were conducted. An operational aircraft survey program for ranch management has subsequently been implemented by the agricultural firm. LANDSAT data was successfully used to produce a ninety-seven percent accurate inventory of cotton over 4.8 million acres of California's San Joaquin Valley. Author

N76-17486* Anderson, Clayton and Co., Houston, Tex.
PRACTICAL APPLICATION OF REMOTE SENSING IN AGRICULTURE
Richard A. Phelps *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 239-242 refs (For availability see N76-17469 08-43)
(A-18) CSCL 02C

Remote sensing program imagery from several types of platforms, from light aircraft to the LANDSAT (ERTS) satellites, have been utilized during the past few years, with preference for inexpensive imagery over expensive magnetic tapes. Emphasis has been on practical application of remote sensing data to increase crop yield by decreasing plant stress, disease, weeds and undesirable insects and by improving irrigation. Imagery obtained from low altitudes via aircraft provides the necessary resolution and complements but does not replace data from high altitude aircraft, Gemini and Apollo spacecraft, Skylab space station and LANDSAT satellites. Federal government centers are now able to supply imagery within about thirty days from data of order. Nevertheless, if the full potential of space imagery in practical agricultural operations is to be realized, the time span from date of imaging to user application needs to be shortened from the current several months to not more than two weeks. Author

N76-17487* Texas Parks and Wildlife Dept., Austin.
WILDLIFE MANAGEMENT BY HABITAT UNITS: A PRELIMINARY PLAN OF ACTION
Carl D. Frentress and Roy G. Frye *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 245-262 refs (For availability see N76-17469 08-43)
(E-1) CSCL 06C

Procedures for yielding vegetation type maps were developed using LANDSAT data and a computer assisted classification analysis (LARSYS) to assist in managing populations of wildlife species by defined area units. Ground cover in Travis County, Texas was classified on two occasions using a modified version of the unsupervised approach to classification. The first classification produced a total of 17 classes. Examination revealed that further grouping was justified. A second analysis produced 10 classes which were displayed on printouts which were later color-coded. The final classification was 82 percent accurate. While the classification map appeared to satisfactorily depict the existing vegetation, two classes were determined to contain significant error. The major sources of error could have been eliminated by stratifying cluster sites more closely among previously mapped soil associations that are identified with particular plant associations and by precisely defining class nomenclature using established criteria early in the analysis. Author

N76-17488* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AN OVERVIEW OF THE DEVELOPMENT OF REMOTE SENSING TECHNIQUES FOR THE SCREWWORM ERADICATION PROGRAM
Charles M. Barnes and Frank C. Forsberg (Lockheed Electronics Co., Houston, Tex.) *In its* NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 263-287 refs (For availability see N76-17469 08-43)
(E-2) CSCL 06C

The current status of remote sensing techniques developed for the screwworm eradication program of the Mexican-American Screwworm Eradication Commission was reported. A review of the type of data and equipment used in the program is presented. Future applications of remote sensing techniques are considered. Author

N76-17489* Lockheed Electronics Co., Houston, Tex.
THE RATIONALE FOR ATTEMPTING TO DEFINE SALT MARSH MOSQUITO-BREEDING AREAS IN GALVESTON COUNTY BY REMOTE SENSING THE ASSOCIATED VEGETATION
Gerald K. Arp *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 289-299 refs (For availability see N76-17469 08-43)
(E-3) CSCL 06C

The rationale for attempting to define salt marsh mosquito breeding areas in Galveston County was discussed, including a botanical survey of the marsh plant communities, their relationship to flooding, and their exposure to salt water. Particular emphasis is given to Distichlis spicata, a widespread marsh grass. Evidence suggests that breeding areas of Aedes sollicitans are associated with Distichlis and that both species respond to similar ecological conditions in the salt marsh. Aspects of the remote sensing of the Distichlis are considered. Author

N76-17490* Texas Univ. Health Science Center, Houston. School of Public Health.
PREDICTION OF HEALTH LEVELS BY REMOTE SENSING
Marjorie Rush and Sally Vernon *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 301-308 refs (For availability see N76-17469 08-43)
(E-4) CSCL 06I

Measures of the environment derived from remote sensing were compared to census population/housing measures in their ability to discriminate among health status areas in two urban communities. Three hypotheses were developed to explore the relationships between environmental and health data. Univariate and multiple step-wise linear regression analyses were performed on data from two sample areas in Houston and Galveston, Texas. Environmental data gathered by remote sensing were found to equal or surpass census data in predicting rates of health outcomes. Remote sensing offers the advantages of data collection for any chosen area or time interval, flexibilities not allowed by the decennial census. Author

N76-17491* Earth Satellite Corp., Washington, D.C.
APPLICATION OF EREP, LANDSAT, AND AIRCRAFT IMAGE DATA TO ENVIRONMENTAL PROBLEMS RELATED TO COAL MINING
Roger V. Amato, Orville R. Russell, Kenneth R. Martin, and Charles E. Wier (Indiana Geol. Survey, Bloomington) *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 309-327 refs (For availability see N76-17469 08-43)
(E-6) CSCL 08I

Remote sensing techniques were used to study coal mining sites within the Eastern Interior Coal Basin (Indiana, Illinois, and western Kentucky), the Appalachian Coal Basin (Ohio, West Virginia, and Pennsylvania) and the anthracite coal basins of northeastern Pennsylvania. Remote sensor data evaluated during these studies were acquired by LANDSAT, Skylab and both high and low altitude aircraft. Airborne sensors included multispectral scanners, multiband cameras and standard mapping cameras loaded with panchromatic, color and color infrared films. The research conducted in these areas is a useful prerequisite to the development of an operational monitoring system that can be peridically employed to supply state and federal regulatory agencies with supportive data. Further research, however, must be undertaken to systematically examine those mining processes and features that can be monitored cost effectively using remote sensors and for determining what combination of sensors and ground sampling processes provide the optimum combination for an operational system. Author

N76-17492* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT INVENTORY OF SURFACE-MINED AREAS USING EXTENDIBLE DIGITAL TECHNIQUES
Arthur T. Anderson, Dorothy T. Schultz (Gen. Elec. Co., Beltsville,

Md.), and Ned Buchman (Gen. Elec. Co., Beltsville, Md.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 329-345 refs (For availability see N76-17469 08-43)
(E-7) CSCL 08I

Multispectral LANDSAT imagery was analyzed to provide a rapid and accurate means of identification, classification, and measurement of strip-mined surfaces in Western Maryland. Four band analysis allows distinction of a variety of strip-mine associated classes, but has limited extendibility. A method for surface area measurements of strip mines, which is both geographically and temporally extendible, has been developed using band-ratioed LANDSAT reflectance data. The accuracy of area measurement by this method, averaged over three LANDSAT scenes taken between September 1972 and July 1974, is greater than 93%. Total affected acreage of large (50 hectare/124 acre) mines can be measured to within 1.0%. Author

N76-17493* Kansas Univ., Lawrence.
QUANTITATIVE WATER QUALITY WITH LANDSAT AND SKYLAB
Harold Yarger and James R. McCauley *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 347-370 refs (For availability see N76-17469 08-47)
(E-9) CSCL 08H

Correlation studies were completed between LANDSAT Multispectral Scanner (MSS) band ratios derived from computer compatible tape (CCT) and 170 water samples taken from three large Kansas reservoirs, coincident with 16 different LANDSAT passes over a 13 month period. The following conclusions were obtained: (1) LANDSAT MSS reflectance levels are useful for quantitative measurement of suspended solids up to at least 900 ppm, (2) MSS band ratios derived from CCT can measure suspended solids with 67% confidence level accuracy of 12 ppm over the range 0-80 ppm and 35 ppm over the range 0900 ppm, (3) suspended solids contour maps can be easily constructed from CCT for water bodies larger than approximately 100 acres, (4) rationing suppresses MSS reflectance level dependence on seasonal sun angle variation and permits measurement of suspended load the year round in the middle latitudes. SKYLAB imagery from a single pass over three reservoirs compares favorably to LANDSAT results up to 100 ppm. Author

N76-17494* Virginia State Water Control Board, Richmond. Div. of Surveillance and Field Studies.
LANDSAT-1 DATA AS IT HAS BEEN APPLIED FOR LAND USE AND WATER QUALITY DATA BY THE VIRGINIA STATE WATER CONTROL BOARD. 1: THE STATE PROJECT. 2: MONITORING WATER QUALITY FROM LANDSAT
Peter L. Trexler and John L. Barker (NASA. Goddard Space Flight Center) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 371-418 refs (For availability see N76-17469 08-43)
(E-10) CSCL 08H

LANDSAT-1 imagery has been used for water quality and land use monitoring in and around the Swift Creek and Lake Chesdin Reservoirs in Virginia. This has proved useful by (1) helping determine valid reservoir sampling stations, (2) monitoring areas not accessible by land or water, (3) giving the State a viable means of measuring Secchi depth readings in these inaccessible areas, (4) giving an overview of trends in changing sedimentation loadings over a given time period and classifying these waters into various categories, (5) enabling the State to inventory all major lakes and reservoirs and computing their acreage, (6) monitoring land use changes in any specific area, (7) evaluating possible long-term environmental effects of nearby developments, and (8) monitoring and predicting population shifts with possible impact on water quality problems. The main problems in the long-term use of such imagery appear to be cost and lack of consistency due to cloud cover limitations. Author

N76-17495* Environmental Protection Agency, Corvallis, Oreg. Eutrophication Survey Branch.
THE LANDSAT-1 MULTISPECTRAL SCANNER AS A TOOL IN THE CLASSIFICATION OF INLAND LAKES
D. H. P. Boland and Richard J. Blackwell (Jet Propulsion Lab., Pasadena, Calif.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 419-442 refs (For availability see N76-17469 08-43)
(E-11) CSCL 08H

Relationships between LANDSAT-1 multispectral scanner (MSS) data and the trophic status of a group of lakes in the north-northeastern part of the United States were studied by predicting the magnitudes of two trophic state indicators, estimating lake position on a multivariate trophic scale, and automatically classifying lakes according to their trophic state. Initially, the principal component ordination was employed with 100 lakes. MSS data for some 20 lakes was then extracted from computer-compatible tapes (CCT) using a binary marking technique. The output was in the form of descriptive statistics and photographic concatenations. Color ratios were incorporated into regression models for the prediction of Secchi disc transparency, chlorophyll a, and lake position on the tropic scale. Results indicate that the LANDSAT-1 system, although handicapped by low spectral and spatial resolutions as well as excessive cloud cover, can be used as a supplemental data source in lake survey programs. Author

N76-17496* Wisconsin Univ., Madison. Inst. for Environmental Studies.
TROPHIC STATUS OF INLAND LAKES FROM LANDSAT
Lawrence T. Fisher and Frank L. Scarpace *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 443-450 refs (For availability see N76-17469 08-43)
(E-12) CSCL 08H

A first-cut assessment of the trophic status of inland lakes in Wisconsin was obtained from LANDSAT data. To satisfy the criteria of the project, a large and versatile computer program was developed to gain access to LANDSAT data. This analysis technique has proven to be a cost-effective method of classifying inland lakes in Wisconsin. Author

N76-17497* Lund Univ. (Sweden). Dept. of Physical Geography.
THE USE OF LANDSAT-1 IMAGERY FOR WATER QUALITY STUDIES IN SOUTHERN SCANDINAVIA
Ulf Hellden *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 451-468 refs (For availability see N76-17469 08-43)
(E-13) CSCL 08H

The possibilities of using LANDSAT-1 images for environmental studies, with special references to water quality studies, were investigated by selecting test areas in southern Scandinavia. The MSS images of different bands are compared under the magnification of an Interpretoscope and densitometric analyses are performed in a Schnell-photometer. The possibility of tracing pollution plumes is studied in the Oresund outside Copenhagen. The effect of different sewers and the circulation of the polluted water is analyzed in various situations. The variation in reflectivity of a great number of lakes in South and Middle Sweden is studied by means of densitometric analyses and significant regional differences are found. The correlation with in situ measurements of water quality (turbidity and secchi disc transparency) of the sampled lakes (made by the National Swedish Environment Protection Board) is fairly good. Author

N76-17498* American Univ., Washington, D.C. Dept. of Biology.
COMPARATIVE UTILITY OF LANDSAT-1 AND SKYLAB DATA FOR COASTAL WETLAND MAPPING AND ECOLOGICAL STUDIES
Richard Anderson, Linda Alsid, and Virginia Carter (US Geol. Survey, Reston, Va.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 469-477 refs (For availability see N76-17469 08-43)
(E-14) CSCL 08B

Skylab 190-A photography and LANDSAT-1 analog data have been analyzed to determine coastal wetland mapping potential as a near term substitute for aircraft data and as a long term monitoring tool. The level of detail and accuracy of

each was compared. Skylab data provides more accurate classification of wetland types, better delineation of freshwater marshes and more detailed analysis of drainage patterns. LANDSAT-1 analog data is useful for general classification, boundary definition and monitoring of human impact in wetlands. Author

N76-17499* Geological Survey, Tampa, Fla. Water Resources Div.

AUTOMATIC CATEGORIZATION OF LAND-WATER COVER TYPES OF THE GREEN SWAMP, FLORIDA, USING SKYLAB MULTISPECTRAL SCANNER (S-192) DATA

A. E. Coker, A. L. Higer (Geol. Survey, Miami, Fla.), R. H. Rogers (Bendix Corp., Ann Arbor, Mich.), N. J. Shah (Bendix Corp., Ann Arbor, Mich.), L. Reed (Bendix Corp., Ann Arbor, Mich.), and S. Walker (Bendix Corp., Ann Arbor, Mich.) *In* NASA. Lyndon B. Johnson Space Center. NASA Earth Reseources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 479-506 refs (For availability see N76-17469 08-43)

(E-15) CSCL 08H

The techniques used and the results achieved in the successful application of Skylab Multispectral Scanner (EREP S-192) high-density digital tape data for the automatic categorizing and mapping of land-water cover types in the Green Swamp of Florida were summarized. Data was provided from Skylab pass number 10 on 13 June 1973. Significant results achieved included the automatic mapping of a nine-category and a three-category land-water cover map of the Green Swamp. The land-water cover map was used to make interpretations of a hydrologic condition in the Green Swamp. This type of use marks a significant breakthrough in the processing and utilization of EREP S-192 data. Author

N76-17500* Earth Satellite Corp., Berkeley, Calif.

A COMPARATIVE INTERREGIONAL ANALYSIS OF SELECTED DATA FROM LANDSAT-1 AND EREP FOR THE INVENTORY AND MONITORING OF NATURAL ECOSYSTEMS

Charles E. Poulton *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 507-598 refs (For availability see N76-17469 08-43)

(E-16) CSCL 08F

Comparative statistics were presented on the capability of LANDSAT-1 and three of the Skylab remote sensing systems (S-190A, S-190B, S-192) for the recognition and inventory of analogous natural vegetations and landscape features important in resource allocation and management. Two analogous regions presenting vegetational zonation from salt desert to alpine conditions above the timberline were observed, emphasizing the visual interpretation mode in the investigation. An hierarchical legend system was used as the basic classification of all land surface features. Comparative tests were run on image identifiability with the different sensor systems, and mapping and interpretation tests were made both in monocular and stereo interpretation with all systems except the S-192. Significant advantage was found in the use of stereo from space when image analysis is by visual or visual-machine-aided interactive systems. Some cost factors in mapping from space are identified. The various image types are compared and an operational system is postulated. Author

N76-17501*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 1-B: GEOLOGY, INFORMATION SYSTEMS AND SERVICES First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data

Jun. 1975 893 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-A N76-17469; Vol. 1-C N76-17552; Vol. 1-D N76-175 ; Vol. 3 N76-17613; Original contains color imagery. Original NASA photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(NASA-TM-X-58168-Vol-1-B; JSC-09930-Vol-1-B) Avail: NTIS HC $7.25 CSCL 05B

A symposium was conducted on the practical applications of earth resources survey technology including utilization and results of data from programs involving LANDSAT, the Skylab earth resources experiment package, and aircraft. Topics discussed include geological structure, landform surveys, energy and extractive resources, and information systems and services. For individual titles, see N76-17502 through N76-17551.

N76-17502* Continental Oil Co., Ponca City, Okla.

SLAR RECONNAISSANCE, MIMIKA-EILANDEN BASIN, SOUTHERN TROUGH OF IRIAN JAYA

R. S. Wing and J. C. Mueller *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 599-604 refs (For availability see N76-17501 08-43)

(G-1) CSCL 08B

The SLAR was obtained in early April 1973 by means of an AN/APQ-97 K-band brute-force system. The flight strips are all north-look, with ground-range display, and 60% overlap. The interpretation was compiled on a 1/100,000-scale mosaic, but the actual mapping of contacts, dips, lineaments, and the like, was done on 1/100,000-scale stereo-strips. Initial regional mapping was intended as an aid in determining that part of the Southern Trough most likely to be underlain by relatively unmetamorphosed paralic Kembelangan sandstones ideally interdigitated with marine source and cape shales. SLAR reconnaissance mapping met a subsequent need to rapidly and inexpensively narrow the search to that part of the 'fairway' coincident with a favorable structure. The SLAR mosaic clearly displays the Irian mountains, strongly and gently folded foothills belts, and the southern front of the fold belt south of which is a large complex of alluvial fans. Author

N76-17503* Chevron Overseas Petroleum, Inc., San Francisco, Calif.

LANDSAT IMAGE STUDIES AS APPLIED TO PETROLEUM EXPLORATION IN KENYA

John B. Miller *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 605-624 refs (For availability see N76-17501 08-43)

(G-2) CSCL 08G

The Chevron-Kenya oil license, acquired in 1972, covers an area at the north end of the Lamu Embayment. Immediately after acquisition, a photogeologic study of the area was made followed by a short field inspection. An interpretation of LANDSAT-1 images as a separate attempt to improve geological knowledge was completed. The method used in the image study, the multispectral characteristics of rock units and terrain, and the observed anomalous features as seen in the LANDSAT imagery are described. It was found that the study helped to define the relationship of the Lamu Embayment and its internal structure with surrounding regional features, such as the East Africa rifting, the Rudolf Trough, the Bur Acaba structural ridge, and the Ogaden Basin. Author

N76-17504* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

DETECTABILITY OF GEOTHERMAL AREAS USING SKYLAB X-5 DATA

Barry S. Siegal, Anne B. Kahle, Alexander F. H. Goetz, Alan R. Gillespie, and Michael J. Abrams *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 625-640 refs (For availability see N76-17501 08-43)

(G-3) CSCL 08G

The results are presented of a study which was undertaken to determine if data from a single near-noon pass of Skylab could be used to detect geothermal areas. The size and temperature requirements for a geothermally heated area to be seen by Skylab S-192 MSS X-5 thermal sensor were calculated. This sensor obtained thermal data with the highest spatial resolution of any nonmilitary satellite system. Only very large hot areas could be expected to be unambiguously recognized with a single data set from this instrument. The study area chosen was The Geysers geothermal field in Sonoma County, California, the only geothermal area of significant size scanned by Skylab. Unfortunately, 95% of the Skylab thermal channel data was acquired within 3 hours of local noon. For The Geysers area only daytime X-5 data were available. An analysis of the thermal channel data (10.2 to 12.5 um) revealed that ground temperatures determined by Skylab were normally distributed.

No anomalous hot spots were apparent. Computer enhancement techniques were used to delineate the hottest 100 and 300 ground areas (pixel, 75 m by 75 m) within the study region. It was found that the Skylab MSS with the X-5 thermal detector does not have sufficient spatial resolution to locate unambiguously from daytime data any but the largest and hottest convectively created geothermal features, which in general are prominent enough to have been previously recognized. Author

N76-17505* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ANATOMY OF AN ANOMALY
Nicholas M. Short and Ronald W. Marrs (Wyoming Univ.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 641-663 refs (For availability see N76-17501 08-43)
(G-5) CSCL 08G

An anomalous tonal pattern, apparently associated with the Beaver Creek oil field in central Wyoming, was identified using an MSS Band 5 to 4 ratio image made from digital LANDSAT data. This pattern was attributed to an increase in iron with rocks and/or soils which might have resulted from escaping hydrocarbons. The nature of this anomaly was investigated by producing several different combinations of band ratios and by conducting appropriate field studies. The results indicated (1) the existence of a well-defined oval feature related to exposure of iron-cemented red sandstones in a badlands topography, (2) a broader iron-influenced anomaly surrounding this feature, and (3) a spectral response of the rocks, soils, and alluvium making up this iron-colored surface that is readily distinguishable from that of iron-rich reddish Chugwater siltstones exposed in nearby anticlines. The general pattern of the broad anomaly extending beyond the Beaver Creek field is controlled by several factors including variations in vegetation (mainly sage and tall grasses), soil composition and moisture, and topography in addition to variations in iron content of the rock materials. From the available evidence, there is no provable correlation between the oval or the broad anomalies and the distribution of petroleum-producing structures or possible surface alteration effects related to uranium deposits known to occur within this region. Author

N76-17506* Bechtold Satellite Technology Corp., City of Industry, Calif.
APPLICATION OF SKYLAB IMAGERY TO RESOURCE EXPLORATION IN THE DEATH VALLEY REGION
Ira C. Bechtold, John T. Reynolds, and C. Gregory Wagner *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 665-672 refs (For availability see N76-17501 08-43)
(G-7) CSCL 08F

The Hunter Mountain plateau in the northern Panamint Range, California, exhibits anomalous topographic, vegetative, color and structural features in Skylab and LANDSAT satellite images which have strong correlation with mineralized areas and should prove significant for future exploration. Data observed to date were studied with reference to published geology and is interpreted in terms of greatest probability of ore mineralization. Further study in conjunction with space imagery analysis is recommended for location of potential mineral zones. Author

N76-17507* Utah Univ., Salt Lake City.
SUMMARY OF SPACE IMAGERY STUDIES IN UTAH AND NEVADA
Mead LeRoy Jensen and Philip Laylander *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 673-712 refs (For availability see N76-17501 08-43)
(G-9) Avail: NTIS CSCL 08B

LANDSAT-1, Skylab, and RB-57 imagery acquired within days of each other of the San Rafael swell enabled geological mapping of individual formations of the southern portion of this broad anticlinal feature in eastern Utah. Mapping at a scale of 1/250,000 on an enhanced and enlarged S-190B image resulted in a geological map showing correlative mappable features that are indicated on the geological map of Utah at the same scale. An enhanced enlargement of an S-190B color image at a scale of 1/19,200 of the Bingham Porphyry Copper deposit allowed comparison of a geological map of the area with the space imagery map as fair for the intrusion boundaries and total lack of quality for mapping the sediments. Hydrothermal alteration is only slightly evident on space imagery at Bingham but in the Tintic mining district and the volcanic piles of the Keg and Thomas ranges, Utah, hydrothermal alteration is readily mapped on color enlargements of S-190B (SL-3, T3-3N Tr-2). A mercury soil-gas analyzer was developed for locating hidden mineralized zones which were suggested from space imagery. Author

N76-17508* Colorado School of Mines, Golden. Geology Dept.
GEOLOGICAL SIGNIFICANCE OF FEATURES OBSERVED IN COLORADO FROM ORBITAL ALTITUDES
Don L. Sawatzky, Gary Prost, Keenan Lee, and D. H. Knepper *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 713-760 refs (For availability see N76-17501 08-43)
(G-10) CSCL 08G

Three major investigations using LANDSAT and Skylab imagery concerned with analyses of color anomalies and linear features of central Colorado are discussed. The studies conducted are concerned with the geological significance of spectral and spatial features on the images. Color anomalies in Skylab photographs were analyzed and evaluated for locating indicators of mineralization. The relationships were determined of all linear features in a LANDSAT image to the rock joint systems and the detectable larger geologic structures; techniques for extracting that geologic information are indicated. Some anomalous megalinear features in LANDSAT and Skylab images are analyzed which transect major structures and, their associated geologic features are described. Author

N76-17509* Alaska Univ., Fairbanks.
THE APPLICATION OF RADAR IMAGERY TO SPECIFIC PROBLEMS OF INTERIOR ALASKA
P. Jan Cannon *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 761-767 refs (For availability see N76-17501 08-43)
(G-11) CSCL 17I

The possible applications are discussed of side-looking airborne radar imagery to specific geomorphic and environmental geologic problems in interior Alaska. The radar imagery described was acquired in July, 1972, by the NASA NP3A aircraft, as part of Mission 209 of the Earth Resources Aircraft Project. The frequency of the radar energy that was transmitted and recorded by the radar system was 16.5 Gigahertz; the wavelength of the radiant energy was about 1.8 centimeters. The radar system operated in both the real aperture and synthetic aperture modes simultaneously. Author

N76-17510* Arkansas Univ., Fayetteville. Dept. of Geology.
LANDSAT IMAGERY ANALYSIS: AN AID FOR PREDICTING LANDSLIDE PRONE AREAS FOR HIGHWAY CONSTRUCTION
Harold C. MacDonald and Robert S. Grubbs *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 769-778 refs (For availability see N76-17501 08-43)
(G-12) CSCL 08B

The most obvious landform features of geologic significance revealed on LANDSAT imagery are linear trends or lineaments. These trends were found to correspond, at least to a large degree, with unmapped faults or complex fracture zones. LANDSAT imagery analysis in northern Arkansas revealed a lineament complex which provides a remarkable correlation with landslide-prone areas along major highway routes. The weathering properties of various rock types, which are considered in designing stable cut slopes and drainage structures, appear to be adversely influenced by the location and trends of LANDSAT defined lineaments. Geologic interpretation of LANDSAT imagery, where applicable and utilized effectively, provides the highway engineer with a tool for predicting and evaluating landslide-prone areas. Author

N76-17511* California Earth Science Corp., Santa Monica.
ACTIVE AND INACTIVE FAULTS IN SOUTHERN CALIFORNIA VIEWED FROM SKYLAB
P. M. Merifield and D. L. Lamar *In* NASA. Lyndon B. Johnson

Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 779-797 refs (For availability see N76-17501 08-43)
CSCL 08B

The application is discussed of Skylab imagery along with larger scale photography and field investigations in preparing fault maps of California for use in land use planning. The images were used to assist in distinguishing active from inactive faults (by recognizing indications of recent displacement), determining the length of potentially active faults, identifying previously unmapped faults, and gaining additional information on regional tectonic history. Author

N76-17512* D'Appolonia (E.) Consulting Engineers, Inc., Pittsburgh, Pa.
THE UTILIZATION OF LANDSAT IMAGERY IN NUCLEAR POWER PLANT SITING
A. J. Eggenberger, D. Rowlands, and P. C. Rizzo *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 799-832 refs (For availability see N76-17501 08-43)
(G-14) CSCL 08B

LANDSAT imagery was used primarily to map geologic features such as lineaments, linears, faults, and other major geologic structures which affect site selection for a nuclear power plant. Areas studied include Pakistan, the South Carolina Piedmont, and Huelva, Spain. Author

N76-17513* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SMALL-SCALE IMAGERY: A USEFUL TOOL FOR MAPPING GEOLOGICAL FEATURES IN THE TEXAS GULF COASTAL PLAIN
David L. Amsbury, Uel S. Clanton, and Von R. Frierson *In its* NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 833-349 refs (For availability see N76-17501 08-43)
(G-15) CSCL 08B

A sample of satellite imagery includes photographs and multispectral scanner imagery from the Apollo, LANDSAT, and Skylab spacecraft over an area west of Houston, Texas. Large circular features and lineaments can readily be mapped. One of the circular features identified by drainage, vegetation, and soil-tone anomalies, occurs in Fort Bend County, Texas, and covers an area about 25 miles in diameter. Another circular feature lies to the north, immediately west of Houston, and is about 15 miles in diameter. These features represent the surface expression of deeply-buried positive structures. It is recommended that regional geological studies begin with photointerpretations of high-altitude aircraft and synoptic space imagery, space imagery provides the synoptic view of rapid evaluation of large-scale features, and, at enlarged scales, the resolution required for detailed study of selected areas of structures. Author

N76-17514* Laboratori della Geofisica della Litosfera, Milan (Italy).
APPLICATION OF SKYLAB IMAGERY TO SOME GEOLOGICAL AND ENVIRONMENTAL PROBLEMS IN ITALY
R. Cassinis, G. M. Lechi, and A. M. Tonelli *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 851-867 refs (For availability see N76-17501 08-43)
(G-16) CSCL 08G

Four topics are considered: regional geology of Sicily, volcanic surveillance in southern Italy, hydrogeology (with special regard given to the discovery and mapping of paleoriverbeds), and crop investigation. The discovery of unknown lineaments and structures in Sicily contributes to the geological knowledge of this region and in particular to the mechanical phenomena involving the upper part of the crust. An attempt was made to relate the status of vegetation surrounding Etna volcano to the magmatic gas escapes filtering through the soil. False-color Skylab images were used to analyze the vigor of the Etnean forestal belt vegetation canopy in order to map possible gas-vent ways as well as the 'active' microfractures. In northern Italy, buried channels were mapped in the Venetian Plain, and a tentative cost-benefit evaluation was done in the field of vegetational studies, both disease detection and species inventory were performed in the Po River Delta and in northwestern Italy. Author

N76-17515* Michigan Technological Univ., Houghton.
SKYLAB PHOTOGRAPHY APPLIED TO GEOLOGIC MAPPING IN NORTHWESTERN CENTRAL AMERICA
W. I. Rose, Jr., D. J. Johnson, G. A. Hahn, and G. W. Johns *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 869-884 refs (For availability see N76-17501 08-43)
(G-17) CSCL 08G

Two photolineation maps of southwestern Guatemala and Chiapas were made from S190 photographs along a ground track from Acajutla, El Salvador to San Cristobal de las Casas, Mexico. The maps document a structural complexity spanning the presumed triple junction of the Cocos, Americas, and Caribbean plates. The Polochic fault zone, supposedly the Americas-Caribbean plate boundary, is a sharply delineated feature across western Guatemala. Westward of the Mexican border it splays into a large number of faults with NW to SW trends. The structural pattern is quite different to the north (Americas plate) and to the south (Caribbean plate) of the Polochic fault, though both areas are dominated by NW-trending lineations. Within the Central American volcanic chain, the lineation patterns support the segmented model of the Benioff Zone, by showing a concentration of transverse lineations in the predicted locations, most notably NE-trending elements near Quezaltenango, Guatemala. The structural pattern obtained from the maps are compared to patterns described on recently published maps of more southerly parts of Central America, to begin a synthesis of the structure of the convergent plate boundary. Author

N76-17516* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
QUANTIFICATION OF GEOLOGIC LINEAMENTS BY MANUAL AND MACHINE PROCESSING TECHNIQUES
Melvin H. Podwysocki, Johannes G. Moik (Computer Sciences Corp., Silver Spring, Md.), and Walter C. Shoup (Computer Sciences Corp., Silver Spring, Md.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 885-903 refs (For availability see N76-17501 08-43)
(G-19) CSCL 08G

A study was conducted to investigate the effect of operator variability and subjectivity in lineament mapping and to examine methods to minimize or eliminate these problems by use of several machine preprocessing methods. LANDSAT scenes from the Anadarko Basin of Oklahoma and the Colorado Plateau were analyzed as test cases. Four geologists mapped lineaments on an Anadarko Basin scene, using transparencies of MSS bands 4-7, and their results are compared statistically. The total number of fractures mapped by the operators and their average lengths varied considerably, although comparison of lineament directions revealed some consensus. A summary map (785 linears) produced by overlaying the maps generated by the four operators showed that only 0.4% were recognized by all four operators, 4.7% by three, 17.8% by two and 77% by one operator. Two methods of machine aided mapping were tested, both simulating directional filters. One consists of computer (digital) processing of CCTs using edge enhancement algorithms, the other employs a television (analog) scanning of an image transparency which superimposes the original image and one offset in the direction of the scan line. Author

N76-17517* Institut Francais du Petrole, Rueil-Malmaison.
CREATING A SYSTEM FOR THE GEOLOGICAL EXPLOITATION OF SATELLITE IMAGES: AUTOMATIC MAPPING AND GEOPHYSICAL DATA COMPARISON
S. Braconne, M. Cavalier, M. Dubesset, J. Guillemot, and M. Guy *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 905-931 refs (For availability see N76-17501 08-43)
(G-20) CSCL 08G

A method is presented for integrating satellite images into a geophysical data interpretation system. Aspects of the method include: an attempt to automatically interpret images by structural, mainly topological, methods for the mapping of geological contours; an analysis of the position relation of the contours gives a skeleton stratigraphy (order of succession); and a system combining some of the extracted elements with geographic

data to make an objective search for an interpretation hypothesis. Some examples are presented. Author

N76-17518* Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.
APPLICATION OF SATELLITE PHOTOGRAPHIC AND MSS DATA TO SELECTED GEOLOGIC AND NATURAL RESOURCE PROBLEMS IN PENNSYLVANIA. 1: LINEAMENTS AND MINERAL OCCURRENCES IN PENNSYLVANIA. 2: RELATION OF LINEAMENTS TO SULFIDE DEPOSITS: BALD EAGLE MOUNTAIN, CENTRE COUNTY, PENNSYLVANIA. 3: COMPARISON OF SKYLAB AND LANDSAT LINEAMENTS WITH JOINT ORIENTATIONS IN NORTH CENTRAL PENNSYLVANIA
W. S. Kowalik, D. P. Gold, and M. Dennis Krohn *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 933-969 refs (For availability see N76-17501 08-43)
(Contracts NAS9-13406; NAS5-23133)
(G-21) CSCL 08G

Those metallic mineral occurrences in Pennsylvania are reported which lie near lineaments mapped from LANDSAT-1 satellite imagery and verified from Skylab photography where available. The lineaments were categorized by degree of expression and type of expression; the mineral occurrences were classified by host rock age, mineralization type, and value. The accompanying tables and figure document the mineral occurrences geographically associated with lineaments and serve as a base for a mineral exploration model. Author

N76-17519* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOLOGICAL MAPPING IN NORTHWESTERN SAUDI ARABIA USING LANDSAT MULTISPECTRAL TECHNIQUES
H. W. Blodget, G. F. Brown (Geological Surv., Reston, Va.), and J. G. Moik (Computer Sciences Corp., Silver Spring, Md.) *In its* NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 971-989 refs (For availability see N76-17501 08-43)
(G-22) CSCL 08G

Various computer enhancement and data extraction systems using LANDSAT data were assessed and used to complement a continuing geologic mapping program. Interactive digital classification techniques using both the maximum-likelihood and thresholding statistical approaches achieve very limited success in areas of highly dissected terrain. Computer enhanced imagery developed by color compositing stretched MSS ratio data was constructed for a test site in northwestern Saudi Arabia. Initial results indicate that several igneous and sedimentary rock-types can be discriminated. Author

N76-17520* Institut Francais du Petrole, Rueil-Malmaison.
ENHANCEMENT OF LANDSAT IMAGERY BY COMBINATION OF MULTISPECTRAL CLASSIFICATION AND PRINCIPAL COMPONENT ANALYSIS
A. Fontanel, C. Blanchet, and C. Lallemand *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 991-1012 refs (For availability see N76-17501 08-43)
(G-24) CSCL 08B

Digital enhancement of LANDSAT imagery was obtained by application of principal component analysis separately on each of the classes previously determined in a multispectral classification step. Each part of the image is thus enhanced whatever its spectral signature may be. A document was obtained which is a synthesis between a conventional image and an ordinary computerized classification. The interpreter can, at the same time, take into account not only the classification but also other features such as context and structure. An example is discussed with the help of geological interpretation. Author

N76-17521* Geological Survey, Reston, Va.
A SEARCH FOR SULFIDE-BEARING AREAS USING LANDSAT-1 DATA AND DIGITAL IMAGE-PROCESSING TECHNIQUES
R. G. Schmidt, B. B. Clark (IBM Corp., Gaithersburg, Md.), and R. Bernstein (IBM Corp., Gaithersburg, Md.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1013-1027 refs (For availability see N76-17501 08-43)
(G-26) CSCL 08G

Two experiments were conducted using LANDSAT-1 multispectral scanner data to identify ground features that are indicators of sulfide-bearing rock. A nearby known sulfide deposit was used as a control. In the first experiment, false-color composites were examined visually to locate possible favorable areas; in the second, favorable areas were classified by digital-computer processing. The results of the experiment show that outcrops of hydrothermally altered and mineralized rock can be identified from LANDSAT-1 data under favorable conditions. The empirical method of digital-computer classification of the multispectral scanner data was relatively unrefined and rapid. The five mineralized prospecting sites identified are in locations that the geologist would not have selected as favorable on the basis of geologic knowledge or photogeologic interpretation at the time of the investigation. Author

N76-17522* Texas Univ., Austin. Bureau of Economic Geology.
REGIONAL INVENTORIES AND MAPPING OF LAND RESOURCES AND ENVIRONMENTAL GEOLOGY USING REMOTELY SENSED DATA
E. G. Wermund, L. F. Brown, Jr., and W. L. Fisher *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1029-1057 refs (For availability see N76-17501 08-43)
CSCL 08B

Black-and-white stereoscopic aerial photographs at a scale of 1:20,000, 1:40,000, and 1:65,000 and controlled aerial photo mosaics at a scale of 1:24,000 were the basic data utilized for most mapping. Color and color infrared aerial photography (1:20,000) was employed to man the barrier islands, and color infrared photography (1:120,000) was used to map sand and mud units of the coastal plain north of Houston. LANDSAT-1 imagery in Bands 4, 5, and 7 (1:250,000) was utilized to examine land use and certain resource units statewide. Side scanning radar and LANDSAT imagery were studied experimentally toward mapping land suitability units in carbonate terranes with high relief and certain other terranes. Large-scale color and color infrared aerial stereoscopic photographs supply the most information for regional mapping. black-and-white photography is the most practical data for mapping because of scale, complete coverage, availability, and relatively low cost. Author

N76-17523* Rockwell International Science Center, Thousand Oaks, Calif.
MINERAL TARGET AREAS IN NEVADA FROM GEOLOGICAL ANALYSIS OF LANDSAT-1 IMAGERY
Monem Abdel-Gawad and Linda Tubbesing *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1059-1078 refs (For availability see N76-17501 08-43)
(G-28) CSCL 08G

Geological analysis of LANDSAT-1 Scene MSS 1053-17540 suggests that certain known mineral districts in east-central Nevada frequently occur near faults or at faults or lineament intersections and areas of complex deformation and flexures. Seventeen (17) areas of analogous characteristics were identified as favorable targets for mineral exploration. During reconnaissance field trips eleven areas were visited. In three areas evidence was found of mining and/or prospecting not known before the field trips. In four areas favorable structural and alteration features were observed which call for more detailed field studies. In one of the four areas limonitic iron oxide samples were found in the regolith of a brecciated dolomite ridge. This area contains quartz veins, granitic and volcanic rocks and lies near the intersection of two linear fault structures identified in the LANDSAT-1 imagery. Semiquantitative spectroscopic analysis of selected portions of the samples showed abnormal contents of arsenic, molybdenum, copper, lead, zinc, and silver. These limonitic samples found were not in situ and further field studies are required to assess their source and significance. Author

N76-17524* National Research Council, Pisa (Italy).
ATTEMPT AT CORRELATING ITALIAN LONG LINEAMENTS FROM LANDSAT-1 SATELLITE IMAGES WITH SOME

GEOLOGICAL PHENOMENA. POSSIBLE USE IN GEOTHERMAL ENERGY RESEARCH

Enrico Barbier and Mario Fanelli *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1079-1086 refs (For availability see N76-17501 08-43)

(G-29) CSCL 08B

By utilizing the images from the LANDSAT-1, in the spectral band 0.8-1.1 microns (near infrared), a photomosaic was obtained of Italian territory. From this mosaic the field of long lineaments was drawn, corresponding to fractures of the earth crust more than 100 km long. The relationship between lineaments, hot springs, volcanic areas, and earthquake epicenters is verified. There is a clear connection between long lineaments and hot springs: 78% of the springs are located on one or more lineaments, and the existence of hot lineaments was observed. A slightly weaker, but still significant, connection exists between the Pliocene-Quaternary volcanic areas and long lineaments. The relationship between earthquakes and long lineaments can only be verified in some cases. The lineaments which can be related to earthquakes have little or no connection with the other phenomena. Author

N76-17525* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

LAYERED CLASSIFICATION TECHNIQUES FOR REMOTE SENSING APPLICATIONS

P. H. Swain, C. L. Wu, D. A. Landgrebe, and H. Hauska *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1087-1097 refs (For availability see N76-17501 08-43)

(Contract NAS9-14016; Grant NGL-15-005-112)

(I-1) CSCL 08B

The single-stage method of pattern classification utilizes all available features in a single test which assigns the unknown to a category according to a specific decision strategy (such as the maximum likelihood strategy). The layered classifier classifies the unknown through a sequence of tests, each of which may be dependent on the outcome of previous tests. Although the layered classifier was originally investigated as a means of improving classification accuracy and efficiency, it was found that in the context of remote sensing data analysis, other advantages also accrue due to many of the special characteristics of both the data and the applications pursued. The layered classifier method and several of the diverse applications of this approach are discussed. Author

N76-17526* Geological Survey, Denver, Colo.

THE MIXTURE PROBLEM IN COMPUTER MAPPING OF TERRAIN: IMPROVED TECHNIQUES FOR ESTABLISHING SPECTRAL SIGNATURE, ATMOSPHERIC PATH RADIANCE, AND TRANSMITTANCE

Harry W. Smedes, Roland L. Hulstrom (Martin Marietta Aerospace Corp., Denver), and K. Jon Ranson (Colorado State Univ.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1099-1159 refs (For availability see N76-17501 08-43)

(I-2) CSCL 08B

The results of LANDSAT and Skylab research programs on the effects of the atmosphere on computer mapping of terrain include: (1) the concept of a ground truth map needs to be drastically revised; (2) the concept of training areas and test areas is not as simple as generally thought because of the problem of pixels that represent a mixture of terrain classes; (3) this mixture problem needs to be more widely recognized and dealt with by techniques of calculating spectral signatures of mixed classes, or by other methods; (4) atmospheric effects should be considered in computer mapping of terrain and in monitoring changes; and (5) terrain features may be used as calibration panels on the ground, from which atmospheric conditions can be determined and monitored. Results are presented of a test area in mountainous terrain of south-central Colorado for which an initial classification was made using simulated mixture-class spectral signatures and actual LANDSAT-1-MSS data. Author

N76-17527* TRW Systems Group, Redondo Beach, Calif.

SECOND GENERATION DIGITAL TECHNIQUES FOR PROCESSING LANDSAT MSS DATA

S. S. Rifman, K. W. Simon, and R. H. Caron *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1161-1175 refs (For availability see N76-17501 08-43)

(I-3) CSCL 05B

Results are reported for precision corrected LANDSAT MSS full scene registration of better than 0.5 picture element (rms), utilizing all digital methods. Examples of such registered full scene images are presented and evaluated by two methods: (1) change detection imagery which represents pixel by pixel the difference of corresponding pixel values in the registered data; and (2) direct measurement of registration errors throughout the imagery by means of a highly accurate cross correlation algorithm. Subscene image details illustrate the impact on registration accuracy of two interpolation algorithms. Author

N76-17528* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE SKYLAB CONCENTRATED ATMOSPHERIC RADIATION PROJECT

Peter M. Kuhn (NOAA, Boulder, Colo.), Victor S. Whitehead, and William E. Marlatt (Colo. State Univ.) *In its* NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1177-1184 refs (For availability see N76-17501 08-43)

(I-4) CSCL 04A

The Skylab field phase in June, August and September of 1973 for the Skylab concentrated atmospheric radiation project provided an opportunity to conduct infrared and solar observations and subsequent calculations beneath the orbiting space vehicle during EREP overpasses. Infrared and solar transmission and absorption properties observed within the atmosphere were compared with EREP experiments, notably the S-191 and S-192. These same observations were later employed in the development and comparison of various atmospheric infrared and solar radiative transfer approximations. Solar radiation observations and calculations in the scattering atmosphere included the 0.4 to 1.1 microns spectral range while infrared observations and calculations covered the spectral band and portions thereof within the 5.0 to 40.0 microns region. Principal conclusions drawn from the solar radiation research and the infrared radiation research are discussed. Author

N76-17529* Stanford Research Inst., Menlo Park, Calif.

MARKING LANDSAT IMAGES WITH SMALL MIRROR REFLECTORS

Wm. E. Evans *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1185-1196 ref (For availability see N76-17501 08-43)

(I-5) CSCL 20F

Uniquely identifiable artificial landmarks were generated in LANDSAT imagery by making use of specular solar reflection from small, easily transportable mirrors. The results are impressive in well-registered color composite enlargements, where the mirror returns appear as bright white spots. The signatures are unique enough that returns can be readily located in the computer compatible tape records either manually or by machine search. As embodied in experiments to date, the system is entirely passive. Mirrors must be carefully positioned prior to each satellite pass, but the required angle calculations are simple enough to be made on a hand calculator and the required input data are easily available. Possible applications of the technique include providing site identification and geodetic control in remote regions of the earth, enhancement of small targets such as offshore oil derricks, providing atmospheric transmission data coincident with other LANDSAT experiments, and providing a nearly perfect optical point source for overall system checkout. Author

N76-17530* Forest Service, Ogden, Utah.

REMOTE SENSING: A VALUABLE TOOL IN THE FOREST SERVICE DECISION MAKING PROCESS

Fleet L. Stanton *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1197-1219 refs (For availability see N76-17501 08-43)

(I-6) CSCL 02F

Forest Service studies for integrating remotely sensed data into existing information systems highlight a need to: (1) re-examine present methods of collecting and organizing data, (2) develop an integrated information system for rapidly processing

and interpreting data, (3) apply existing technological tools in new ways, and (4) provide accurate and timely information for making right management decisions. The Forest Service developed an integrated information system using remote sensors, microdensitometers, computer hardware and software, and interactive accessories. Their efforts substantially reduce the time it takes for collecting and processing data. Author

N76-17531* Pilot Rock, Inc., Calif.
SPACE TECHNOLOGY PUTTING IT IN THE EDUCATIONAL PERSPECTIVE
Donna B. Hankins *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1221-1223 (For availability see N76-17501 08-43)
(I-7) CSCL 05B

One of the precepts of the company was to provide educators with practical, innovative, and manageable audio-visual teaching aids in a wide spectrum of educational fields, but primarily geography, geology and social science. A pilot slide set was prepared, demonstrating primary areas along the entire length of the San Andreas Fault Zone in California and Mexico. This set utilized several NASA infrared research aircraft photos, to more clearly delineate fault traces. A decision was made to mount a massive program of repackaging NASA generated infrared aircraft imagery into topical teaching sets. Author

N76-17532* Nebraska Univ., Lincoln. Coll. of Engineering and Technology.
GROUND ZERO AND UP; NEBRASKA'S RESOURCES AND LAND USE
Donald M. Edwards and Roger Macklem (Nebr. State Dept. of Educ.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1225-1236 ref (For availability see N76-17501 08-43)
(I-8) CSCL 05I

A one-semester high school course was developed about the use of remote sensing techniques for land earth resources planning and management. The slide-tape-workbook program was field tested with high school students to show a substantial increase in gain of knowledge and an attitude change in application of remote sensing techniques. Author

N76-17533* Ecole des Mines, Paris (France).
AN UNSUPERVISED CLASSIFICATION OF MULTISPECTRAL SCANNER DATA USING CORRESPONDENCE ANALYSIS (CLAMS)
J-M. Monget and P. Roux *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1237-1244 refs (For availability see N76-17501 08-43)
(I-9) CSCL 05B

An unsupervised classification method was designed as a three step procedure: dimension reduction, classification of channels and clustering of measured reflectance spectra. The basic concept is that similar channels are most likely to characterize typical shapes of reflectance spectrum. Some results are shown which are in good agreement with the known ground truth. Author

N76-17534* Environmental Research Inst. of Michigan, Ann Arbor.
ADVANCES IN AUTOMATIC EXTRACTION OF EARTH RESOURCES INFORMATION FROM MULTISPECTRAL SCANNER DATA
Jon D. Erickson *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1245-1274 refs (For availability see N76-17501 08-43)
(Contracts NAS9-14123; NAS1-13128; NAS1-11979)
(I-10) CSCL 05B

The basis of spectral discrimination was briefly examined indicating sources of variability which tend to obscure the spectral attributes of the classes of interest. Spatial and temporal discrimination bases are also discussed. Automatic processing functions, techniques and methods, and equipment are discussed with emphasis on techniques and equipment required for operational large area surveys with satellite data. Techniques for carrying out major functions of preprocessing for signature extension, feature extraction, discrimination, display, and applications modeling were examined. A multiplicative and additive signature correction technique and a proportion estimation technique are discussed. The development of the multivariate interactive digital analysis system multispectral processor system which represents a breakthrough in cost effective high throughput processing for large area surveys from satellites and aircraft is reviewed. Applications and results are discussed briefly for agricultural crop inventories, environmental monitoring, and resources surveys from ERIM LANDSAT and EREP investigations to indicate the substantial progress achieved to date. Author

N76-17535* General Electric Co., Beltsville, Md. Space Systems Dept.
IMAGE 100: THE INTERACTIVE MULTISPECTRAL IMAGE PROCESSING SYSTEM
Earle S. Schaller and Robert W. Towles *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1275-1291 (For availability see N76-17501 08-43)
(I-11) CSCL 14E

The need for rapid, cost-effective extraction of useful information from vast quantities of multispectral imagery available from aircraft or spacecraft has resulted in the design, implementation and application of a state-of-the-art processing system known as IMAGE 100. Operating on the general principle that all objects or materials possess unique spectral characteristics or signatures, the system uses this signature uniqueness to identify similar features in an image by simultaneously analyzing signatures in multiple frequency bands. Pseudo-colors, or themes, are assigned to features having identical spectral characteristics. These themes are displayed on a color CRT, and may be recorded on tape, film, or other media. The system was designed to incorporate key features such as interactive operation, user-oriented displays and controls, and rapid-response machine processing. Owing to these features, the user can readily control and/or modify the analysis process based on his knowledge of the input imagery. Effective use can be made of conventional photographic interpretation skills and state-of-the-art machine analysis techniques in the extraction of useful information from multispectral imagery. This approach results in highly accurate multitheme classification of imagery in seconds or minutes rather than the hours often involved in processing using other means. Author

N76-17536* Woodward-Clyde Consultants, Clifton, N.J.
GEOLOGIC ANALYSES OF LANDSAT-1 MULTISPECTRAL IMAGERY OF A POSSIBLE POWER PLANT SITE EMPLOYING DIGITAL AND ANALOG IMAGE PROCESSING
Jon R. Lovegreen, William J. Prosser, and Richard A. Millet *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1293-1308 refs (For availability see N76-17501 08-43)
(I-12) CSCL 08F

A site in the Great Valley subsection of the Valley and Ridge physiographic province in eastern Pennsylvania was studied to evaluate the use of digital and analog image processing for geologic investigations. Ground truth at the site was obtained by a field mapping program, a subsurface exploration investigation and a review of available published and unpublished literature. Remote sensing data were analyzed using standard manual techniques. LANDSAT-1 imagery was analyzed using digital image processing employing the multispectral Image 100 system and using analog color processing employing the VP-8 image analyzer. This study deals primarily with linears identified employing image processing and correlation of these linears with known structural features and with linears identified manual interpretation; and the identification of rock outcrops in areas of extensive vegetative cover employing image processing. The results of this study indicate that image processing can be a cost-effective tool for evaluating geologic and linear features for regional studies encompassing large areas such as for power plant siting. Digital image processing can be an effective tool for identifying rock outcrops in areas of heavy vegetative cover. Author

N76-17537* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
THE SCREWWORM ERADICATION DATA SYSTEM (SEDS)

Matthew J. Quinn *In its* NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1309-1312 (For availability see N76-17501 08-43)
(I-13) CSCL 05B

One of the objectives of the SEDS was to build a versatile, yet economical, interactive system on the existing digital PDP 11/45 computers used in the Skylab production processing system. Previous experience on various interactive systems gave some background in the best methods of handling image data, registering and correcting the data, and extracting useful information from the images. The screwworm was eliminated in many parts of the United States by air-dropping sterile screwworms in areas where screwworms breed. The reproduction of the screwworm can be more or less predicted based on weather conditions -- cold weather slows the breeding, warm weather fosters it, and some moisture appears to enhance breeding conditions which, in turn, improves the chances of screwworm population growth. To obtain temperature and moisture conditions from remote areas, the NOAA improved TIROS operational satellite was selected to give data from the very high resolution radiometer (VHRR). The VHRR is a two-channel scanning instrument sensitive to energy in the visible spectrum from 0.6 to 0.7 micrometers and the infrared spectrum from 10.5 to 12.5 micrometers.
Author

N76-17538* Earth Satellite Corp., Kinshasa (Zaire).
LANDSAT ACTIVITIES IN THE REPUBLIC OF ZAIRE
Sendwe Ilunga *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1313-1315 (For availability see N76-17501 08-43)
(I-14) CSCL 05B

An overview of the LANDSAT data utilization program of the Republic of Zaire is presented. The program emphasizes topics of economic significance to the national development program of Zaire: (1) agricultural land use capability analysis, including evaluation of the effects of large-scale burnings; (2) mineral resources evaluation; and (3) production of mapping materials for poorly covered regions.
Author

N76-17539* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMOTE SENSING AS AN INNOVATION: HOW CAN WE IMPROVE ON ITS RATE OF ADOPTION?
Buzz Sellman *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1317-1321 refs (For availability see N76-17501 08-43)
(I-15) CSCL 05B

Earth Resources investigation programs are discussed which were designed to apply contemporary remote sensing technologies to 'user' needs. The potential adopter's environment and arena of work are considered and his expectations and measures of success.
M.J.S.

N76-17540* Bendix Corp., Ann Arbor, Mich.
M-DAS: SYSTEM FOR MULTISPECTRAL DATA ANALYSIS
Robert H. Johnson *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1323-1350 (For availability see N76-17501 08-43)
(I-16) CSCL 05B

M-DAS is a ground data processing system designed for analysis of multispectral data. M-DAS operates on multispectral data from LANDSAT, S-192, M2S and other sources in CCT form. Interactive training by operator-investigators using a variable cursor on a color display was used to derive optimum processing coefficients and data on cluster separability. An advanced multivariate normal-maximum likelihood processing algorithm was used to produce output in various formats: color-coded film images, geometrically corrected map overlays, moving displays of scene sections, coverage tabulations and categorized CCTs. The analysis procedure for M-DAS involves three phases: (1) screening and training, (2) analysis of training data to compute performance predictions and processing coefficients, and (3) processing of multichannel input data into categorized results. Typical M-DAS applications involve iteration between each of these phases. A series of photographs of the M-DAS display are used to illustrate M-DAS operation.
Author

N76-17541* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
ERIPS: EARTH RESOURCE INTERACTIVE PROCESSING SYSTEM
Matthew J. Quinn *In its* NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1351-1353 ref (For availability see N76-17501 08-43)
(I-17) CSCL 05B

The ERIPS is an interactive computer system used in the analysis of remotely sensed data. It consists of a set of software programs which are executed on an IBM System/360 Model 75J computer under the direction of a trained analyst. The software was a derivative of the Purdue LARSYS program and has evolved to include an extensive pattern recognition system and a number of manipulative, preprocessing routines which prepare the imagery for the pattern recognition application. The original purpose of the system was to analyze remotely sensed data, to develop and perfect techniques to process the data, and to determine the feasibility of applying the data to significant earth resources problems. The System developed into a production system. Error recovery and multi-jobbing capabilities were added to the system.
Author

N76-17542* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LOW-COST DATA ANALYSIS SYSTEMS FOR PROCESSING MULTISPECTRAL SCANNER DATA
Sidney L. Whitley *In its* NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1355-1375 refs (For availability see N76-17501 08-43)
(I-18) CSCL 05B

A research-oriented data analysis system was developed which is used for evaluating complex remote sensor systems and for development of techniques for application of remotely sensed data. Some modular hardware components were developed which may be added to one's existing facilities to establish a low-cost data analysis system for processing multispectral scanner data. Software modules which are compatible with small general purpose digital computers process and analyze remote sensor data, and convert it to information needed by users. The software modules are written in FORTRAN IV language for ease of transfer to other computer systems. The basic hardware and software system requirements are defined for some low-cost data analysis systems consisting of an image display system, a small general purpose digital computer, and an output recording device. The hardware modules consist of: a LANDSAT MSS data reformatting program; a series of spectral pattern recognition programs required to generate surface classification maps and tabular information; programs to convert computer generated maps from image space to a geographically referenced base; programs to extract data and irregularly shaped areas and to produce thematic maps of the designated areas; and programs to tabulate acreages of selected classification categories. Some off-the-shelf, inexpensive digital image display systems are described.
Author

N76-17543* California Univ., Berkeley. Remote Sensing Research Program.
THE INTEGRATION OF MANUAL AND AUTOMATIC IMAGE ANALYSIS TECHNIQUES WITH SUPPORTING GROUND DATA IN A MULTISTAGE SAMPLING FRAMEWORK FOR TIMBER RESOURCE INVENTORIES: THREE EXAMPLES
Michael Gialdini, Stephen Titus, James Nichols, and Randall Thomas *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1377-1387 refs (For availability see N76-17501 08-43)
(I-19) CSCL 05B

An approach to information acquisition is discussed in the context of meeting user-specified needs in a cost-effective, timely manner through the use of remote sensing data, ground data, and multistage sampling techniques. The roles of both LANDSAT imagery and Skylab photography are discussed as first stages of three separate multistage timber inventory systems and results are given for each system. Emphasis is placed on accuracy and meeting user needs.
Author

N76-17544* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DESIGN CRITERIA FOR A MULTIPLE INPUT LAND USE SYSTEM

Frederic C. Billingsley and Nevin A. Bryant *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1389-1396 refs (For availability see N76-17501 08-43)
(I-20) CSCL 08B

A design is presented that proposes the use of digital image processing techniques to interface existing geocoded data sets and information management systems with thematic maps and remote sensed imagery. The basic premise is that geocoded data sets can be referenced to a raster scan that is equivalent to a grid cell data set, and that images taken of thematic maps or from remote sensing platforms can be converted to a raster scan. A major advantage of the raster format is that x, y coordinates are implicitly recognized by their position in the scan, and z values can be treated as Boolean layers in a three-dimensional data space. Such a system permits the rapid incorporation of data sets, rapid comparison of data sets, and adaptation to variable scales by resampling the raster scans. Author

N76-17545* Department of Agriculture, Washington, D.C. Western Aerial Photography Lab.
USER SERVICES AVAILABLE FROM USDA'S AERIAL PHOTOGRAPHY FIELD OFFICE
Ronald A. Dickson *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1397-1402 (For availability see N76-17501 08-43)
(I-21) CSCL 05B

APFO furnishes LANDSAT imagery and supporting NASA aircraft imagery to NASA-funded principal investigators who are working within the agriculture discipline. The office holds and reproduces Skylab imagery and a variety of aircraft photography (including infrared) from various government agencies. Available products are listed. Other topics discussed include quality control of photographic materials, analytical aerotriangulation, and photographic processes. Author

N76-17546* Office of Information Services, Austin, Tex.
THE TEXAS REMOTE SENSING TRAINING PROJECT
John B. Wells *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1403-1414 (For availability see N76-17501 08-43)
(I-22) CSCL 05I

The project was designed to train federal, state and regional agency managers, scientists and engineers. A one-week seminar was designed and implemented to build vocabulary, introduce technical subject areas and give students enough training to allow them to relate remote sensing technology to operational agency projects. The seminar was designed to perform the dual function of conveying enough remote sensing information to be of value as a stand-alone and preparing students for detailed pattern recognition training. The LARSYS III portion of the training project was executed exactly as designed in the LARSYS training materials package; the LARSYS package did not contain a LANDSAT training module. Two LANDSAT training modules were developed using Texas LANDSAT data. One module contained central Texas data and the second module contained coastal zone data. Author

N76-17547* ESL, Inc., Sunnyvale, Calif.
INTERACTIVE DIGITAL IMAGE MANIPULATION SYSTEM
Janice Henze and Robert DeZur *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1415-1435 refs (For availability see N76-17501 08-43)
(I-23) CSCL 05B

The system is designed for manipulation, analysis, interpretation, and processing of a wide variety of image data. LANDSAT (ERTS) and other data in digital form can be input directly into the system. Photographic prints and transparencies are first converted to digital form with an on-line high-resolution microdensitometer. The system is implemented on a Hewlett-Packard 3000 computer with 128 K bytes of core memory and a 47.5 megabyte disk. It includes a true color display monitor, with processing memories, graphics overlays, and a movable cursor. Image data formats are flexible so that there is no restriction to a given set of remote sensors. Conversion between data types is available to provide a basis for comparison of the various data. Multispectral data is fully supported, and there is no restriction on the number of dimensions. In this way multispectral data collected at more than one point in time may simply be treated as a data collected with twice (three times, etc.) the number of sensors. There are various libraries of functions available to the user: processing functions, display functions, system functions, and earth resources applications functions. Author

N76-17548* Stanford Research Inst., Menlo Park, Calif.
IMAGE ANIMATION FOR THEME ENHANCEMENT AND CHANGE DETECTION
Wm. E. Evans *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1976 p 1437-1450 refs (For availability see N76-17501 08-43)
(I-24) CSCL 14E

Animated displays are useful in enhancing subtle temporally related changes in scenes viewed by satellites capable of providing repetitive coverage. The detectability of fixed features is also improved through the help of the powerful visual integration process. To expedite the process of assembling and displaying well-registered, time-lapse sequences and to provide means for making quantitative measurements of radiances, displacements, and areas, an electronic satellite image analysis console was constructed. During the LANDSAT-1 program, this equipment was applied to the needs of a number of earth resource investigators with interests principally related to dynamic hydrology. The measurement of the areal extent of snow cover within defined drainage basins is discussed as a representative applications example. Author

N76-17549* General Electric Co., Philadelphia, Pa. Space Div.
THE TOTAL EARTH RESOURCES SYSTEM OF THE 1980'S: A VIEW OF THE FUTURE
Charles E. Cheeseman and David W. Keller *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1451-1472 (For availability see N76-17501 08-43)
(I-25) CSCL 12B

The study was organized to address the total earth resources system in the broadest sense: distinguishing characteristics of the resources form the input, and information from user models forms the output. The effort began with a treatment of resource management requirements which traced information needs back to budgets, laws, and charters. These requirements were used to structure a 1980's scenario and to define thirty broad resource management missions (or applications) which could be confidently expected to be carried out by the future system. A classical systems approach was followed to assess the current state-of-the-art, structure system requirements, and to define the necessary platforms, sensors, and ground system architecture. The study of two resource management missions in additional detail was conducted to illuminate problems of transition from R&D to operational systems. The space shuttle's role in the system received special attention and a mission able to be served by an early flight was defined. Author

N76-17550* General Electric Co., Philadelphia, Pa. Space Div.
EARTH RESOURCES SURVEY AND THE SPACE SHUTTLE
W. Kent Stow and Roman W. Andryczyk *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1473-1482 refs (For availability see N76-17501 08-43)
(I-26) CSCL 22A

The impact that the shuttle is expected to have on the Earth Resources Program and several concepts for exploiting the shuttle characteristics are discussed. The utilization of the space shuttle in its sortie mode for earth resources and the application of an earth observations standard package to earth resources missions were studied. Author

N76-17551* Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
SENSOR EQUIPMENT OF THE GERMAN EARTH SCIENTIFIC AIRPLANE PROGRAM
Peter Seige *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1483-1497 (For availability see N76-17501 08-43)

(I-27) CSCL 14B

The German airplane program for earth scientific research supports the work of a vast staff of earth scientists from universities and federal agencies. Due to their fields of interest, which are in oceanography, hydrology, geology, ecology, and forestry, five test areas were selected which are spread all over Germany. The sensor package, which was designed in accordance with the requirements of this group of scientists, will be installed in a DO 28 D2 type airplane. The sensor equipment consists of a series of 70-mm cameras having different film/filter combinations, a photogrammetric camera, an infrared radiometer, an 11-channel multispectral line scanner, a LANDSAT-compatible radiometer, and a complex avionic system. Along with the airplane, a truck will be equipped with a set of radiometers and other sensor devices for extensive ground-truth measurement; this also includes a cherry picker. Author

N76-17552*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 1-C: LAND USE, MARINE RESOURCES - First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data

Jun. 1975 675 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-A N76-17469; Vol. 1-B N76-17501; Vol. 1-D N76-17588; Vol. 3 N76-17613; Original contains color imagery. Original NASA photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(NASA-TM-X-58168-Vol-1-C; JSC-09930-Vol-1-C) Avail: NTIS HC $7.25 CSCL 05B

Articles are presented on the utilization of remote sensing data from NASA programs involving LANDSAT, the Skylab Earth resources experiment package, and aircraft, as well as from other data acquisition programs. Emphasis is placed on land use and marine resources. For individual titles, see N76-17553 through N76-17587.

N76-17553* South Dakota State Planning Agency, Pierre.

THE SOUTH DAKOTA COOPERATIVE LAND USE EFFORT: A STATE LEVEL REMOTE SENSING DEMONSTRATION PROJECT

Paul A. Tessar, Dennis R. Hood (Geological Survey, Sioux Falls, S. D.), and William J. Todd (Technicolor Graphic Services, Inc., Sioux Falls, S. D.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1499-1523 refs (For availability see N76-17552 08-43)

(L-1) CSCL 08B

Remote sensing technology can satisfy or make significant contributions toward satisfying many of the information needs of governmental natural resource planners and policy makers. Recognizing this potential, the South Dakota State Planning Bureau and the EROS Data Center together formulated the framework for an ongoing Land Use and Natural Resource Inventory and Information System Program. Statewide land use/land cover information is generated from LANDSAT digital data and high altitude photography. Many applications of the system are anticipated as it evolves and data are added from more conventional sources. The conceptualization, design, and implementation of the program are discussed. Author

N76-17554* Georgia Dept. of Natural Resources, Atlanta.

AN EXAMINATION OF THE POTENTIAL APPLICATIONS OF AUTOMATIC CLASSIFICATION TECHNIQUES TO GEORGIA MANAGEMENT PROBLEMS

Bruce Q. Rado *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1525-1540 refs (For availability see N76-17552 08-43)

(L-2) CSCL 05A

Automatic classification techniques are described in relation to future information and natural resource planning systems with emphasis on application to Georgia resource management problems. The concept, design, and purpose of Georgia's statewide Resource AS Assessment Program is reviewed along with participation in a workshop at the Earth Resources Laboratory. Potential areas of application discussed include: agriculture, forestry, water resources, environmental planning, and geology. J.M.S.

N76-17555* Ohio Dept. of Economic and Community Development, Columbus.

OHIO'S STATEWIDE LAND USE INVENTORY: AN OPERATIONAL APPROACH FOR APPLYING LANDSAT DATA TO STATE, REGIONAL AND LOCAL PLANNING PROGRAMS

Paul E. Baldridge, Paul H. Geosling, Frank Leone, Charles Minshall (Battelle Columbus Labs.), Robert H. Rodgers (Bendix Aerospace Corp., Ann Arbor, Mich.), and Carl L. Wilhelm (Ohio EPA) *In* NASA. Lyndon B. Johnson Space Center, NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1541-1552 refs (For availability see N76-17552 08-43)

(L-3) CSCL 08F

The programmatic, technical, user application, and cost factors associated with the development of an operational, statewide land use inventory from LANDSAT data are described. The LANDSAT multispectral data are subjected to geometrical and categorical processing to produce map files for each of the 200 fifteen (15) minute quads covering Ohio. Computer compatible tapes are rescanned to produce inventory tapes which identify eight (8) Level I land use categories and a variety of Level II categories. The inventory tapes are processed through a series of ten (10) software programs developed by the State of Ohio. The net result is a computerized inventory which can be displayed in map or tabular form for various geographic units, at a variety of scales and for selected categories of usage. The computerized inventory data files are applied to technical programs developed by the various state agencies to be used in state, regional, and local planning programs. Author

N76-17556* Geological Survey, Phoenix, Ariz.

ARIZONA LAND USE EXPERIMENT

Carl C. Winikka and Herbert H. Schumann *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1553-1572 refs (For availability see N76-17552 08-43)

(L-4) CSCL 08B

Utilization of new sources of statewide remote sensing data, taken from high-altitude aircraft and from spacecraft is discussed along with incorporation of information extracted from these sources into on-going land and resources management programs in Arizona. Statewide cartographic applications of remote sensor data taken by NASA high-altitude aircraft include the development of a statewide semi-analytic control network, the production of nearly 1900 orthophotoquads (image maps) that are coincident in scale and area with the U.S. Geological Survey (USGS) 7. 5 minute topographic quadrangle map series, and satellite image maps of Arizonza produced from LANDSAt multispectral scanner imagery. These cartographic products are utilized for a wide variety of experimental and operational earth resources applications. Applications of the imagery, image maps, and derived information discussed include: soils and geologic mapping projects, water resources investigations, land use inventories, environmental impact studies, highway route locations and mapping, vegetation cover mapping, wildlife habitat studies, power plant siting studies, statewide delineation of irrigation cropland, position determination of drilling sites, pictorial geographic bases for thematic mapping, and court exhibits. Author

N76-17557* Cornell Univ., Ithaca, N.Y.

THE DESIGN, IMPLEMENTATION, AND USE OF A STATEWIDE LAND USE INVENTORY: THE NEW YORK EXPERIENCE

Ernest E. Hardy *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1573-1602 (For availability see N76-17552 08-43)

(L-5) CSCL 08B

The New York State land use and natural resource inventory is described with emphasis on its design, implementation, and user requirements. Other topics discussed include: classification, data acquisition, geographic referencing, data storage, data retrieval, and documentation. J.M.S.

N76-17558* Alaska Univ., Fairbanks.

ALASKAN RESOURCES, CURRENT DEVELOPMENT, TRADITIONAL CULTURAL VALUES, AND THE ROLE OF LANDSAT DATA IN CURRENT AND FUTURE LAND USE MANAGEMENT PLANNING

Arthur LaPerriere *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1603-1608 refs (For availability see N76-17552 08-43)
(L-6) CSCL 08F

Past, present, and proposed applications of LANDSAT data for renewable resource assessments in Alaska are described. Specific projects briefly discussed include: a feasibility investigation applying LANDSAT data to caribou habitat mapping in northeast Alaska, analysis of a native corporate region in southwest Alaska, analysis of a game management unit in interior Alaska, and two proposed analyses in northwest Alaska. These analyses principally address range evaluations concerning caribou, moose, and Dall sheep, but results have application to other renewable resource themes. Application of resource assessment results to a statewide land use management plan is discussed. Author

N76-17559* Geological Survey, Reston, Va.
THE NATIONAL LAND USE DATA PROGRAM OF THE US GEOLOGICAL SURVEY
James R. Anderson and Richard E. Witmer *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1609-1615 refs (For availability see N76-17552 08-43)
(L-7) CSCL 08B

The Land Use Data and Analysis (LUDA) Program which provides a systematic and comprehensive collection and analysis of land use and land cover data on a nationwide basis is described. Maps are compiled at about 1:125,000 scale showing present land use/cover at Level II of a land use/cover classification system developed by the U.S. Geological Survey in conjunction with other Federal and state agencies and other users. For each of the land use/cover maps produced at 1:125,000 scale, overlays are also compiled showing Federal land ownership, river basins and subbasins, counties, and census county subdivisions. The program utilizes the advanced technology of the Special Mapping Center of the U.S. Geological Survey, high altitude NASA photographs, aerial photographs acquired for the USGS Topographic Division's mapping program, and LANDSAT data in complementary ways. Author

N76-17560* Wisconsin Univ., Madison. Inst. for Environmental Studies.
CASES IN THE RELATION OF RESEARCH ON REMOTE SENSING TO DECISIONMAKERS IN A STATE AGENCY
James W. Jondrow *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1617-1630 refs (For availability see N76-17552 08-43)
(L-8) CSCL 05A

The use is considered of various management tools in order to assess their effects on the anticipated relevance of the remote sensing research to the needs of government agencies. Among these tools are different organizational structures and ways of functioning, which are applied to the design and management of projects and to the communication of research results. The characteristics of data and information flow, and technology transfer are discussed along with the management of three projects and a remote sensing data center in terms of the use of some tools for influencing these processes. Author

N76-17561* Ohio-Kentucky-Indiana Regional Council of Governments, Cincinnati.
THE DEVELOPMENT OF A LAND USE INVENTORY FOR REGIONAL PLANNING USING SATELLITE IMAGERY
A. H. Hessling and Timothy G. Mara *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1631-1636 refs (For availability see N76-17552 08-43)
(L-10) CSCL 05A

Water quality planning in Ohio, Kentucky, and Indiana is reviewed in terms of use of land use data and satellite imagery. A land use inventory applicable to water quality planning and developed through computer processing of LANDSAT-1 imagery is described. J.M.S.

N76-17562* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUMIS: A LAND USE MANAGEMENT INFORMATION SYSTEM FOR URBAN PLANNING
Charles K. Paul *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1637-1664 refs (For availability see N76-17552 08-43)
(L-11) CSCL 05B

The Land Use Management Information System (LUMIS) consists of a methodology of compiling land use maps by means of air photo interpretation techniques, digitizing these and other maps into machine-readable form, and numerically overlaying these various maps in two computer software routines to provide land use and natural resource data files referenced to the individual census block. The two computer routines are the Polygon Intersection Overlay System (PIOS) and an interactive graphics APL program. A block referenced file of land use, natural resources, geology, elevation, slope, and fault-line items has been created and supplied to the Los Angeles Department of City Planning for the City's portion of the Santa Monica Mountains. In addition, the interactive system contains one hundred and seventy-three socio-economic data items created by merging the Third Count U.S. Census Bureau tapes and the Los Angeles County Secured Assessor File. This data can be graphically displayed for each and every block, block group, or tract for six test tracts in Woodland Hills, California. Other benefits of LUMIS are the knowledge of air photo availability, flight pattern coverage and frequencies, and private photogrammetry companies flying Southern California, as well as a formal Delphi study of relevant land use informational needs in the Santa Monicas. Author

N76-17563* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
SATELLITE INFORMATION ON ORLANDO, FLORIDA
John W. Hannah (Brevard County Planning Dept., Fla.), Garland L. Thomas (Brevard County Planning Dept., Fla.), and Fernando Esparza *In its* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1665-1682 ref (For availability see N76-17552 08-43)
(L-13) CSCL 05B

A land use map of Orange County, Florida was prepared from EREP photography while LANDSAT and EREP multispectral scanner data were used to provide more detailed information on Orlando and its suburbs. The generalized maps were prepared by tracing the patterns on an overlay, using an enlarging viewer. Digital analysis of the multispectral scanner data was basically the maximum likelihood classification method with training sample input and computer printer mapping of the results. Urban features delineated by the maps are discussed. It is concluded that computer classification, accompanied by human interpretation and manual simplification can produce land use maps which are useful on a regional, county, and city basis. Author

N76-17564* Geological Survey, Reston, Va.
LAND USE AND ENVIRONMENTAL ASSESSMENT IN THE CENTRAL ATLANTIC REGION
Robert H. Alexander, Katherine Fitzpatrick, Harry F. Lins, Jr., and Herbert K. McGinty, III *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1683-1727 refs (For availability see N76-17552 08-43)
(L-14) CSCL 08F

Data from high altitude aircraft, LANDSAT and Skylab were used in a comprehensive regional survey of land use and its associated environmental impact in the Central Atlantic Regional Ecological Test Site (CARETS). Each sensor system has advantages that were demonstrated by producing experimental land use maps and other data products, applying them to typical problems encountered in regional planning and environmental impact assessment, and presenting the results to prospective users for evaluation. An archival collection of imagery, maps, data summaries, and technical reports was assembled, constituting an environmental profile of the central Atlantic region. The investigation was organized into four closely-related modules, a land use information module, an environmental impact module, a user interaction and evaluation module, and a geographic information systems module. Results revealed a heterogeneous user community with diverse information needs, tending, however, definitely toward the higher-resolution sensor data and the larger-scale land use maps and related information products. Among project recommendations are greater efforts toward improving compatibility of federal, state, and local land use information programs, and greater efforts toward a broader

exchange of imagery, computer tapes, and land use information derived therefrom. Author

N76-17565* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMOTE SENSING IMPACT ON CORRIDOR SELECTION AND PLACEMENT
F. J. Thomson (Environmental Res. Inst. of Michigan, Ann Arbor) and A. N. Sellman *In its* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1729-1745 refs (For availability see N76-17552 08-43)
(L-15) CSCL 08B

Computer-aided corridor selection techniques, utilizing digitized data bases of socio-economic, census, and cadastral data, and developed for highway corridor routing are considered. Land resource data generated from various remote sensing data sources were successfully merged with the ancillary data files of a corridor selection model and prototype highway corridors were designed using the combined data set. Remote sensing derived information considered useful for highway corridor location, special considerations in geometric correction of remote sensing data to facilitate merging it with ancillary data files, and special interface requirements are briefly discussed. Author

N76-17566* Michigan State Univ., East Lansing.
IMPROVED RESOURCE USE DECISIONS AND ACTIONS THROUGH REMOTE SENSING
R. Hill-Rowley, M. Boylan, W. Enslin, and R. D. Vlasin *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1747-1767 (For availability see N76-17552 08-43)
(L-16) CSCL 05A

Operational uses of remote sensing for improving management decisions and actions concerning resource uses are considered in terms of first generation, or direct-action; and second generation or indirect, delayed-action applications. From among applications completed during 1974-75, seven case studies are offered in illustration of the many contrasts which can be drawn between first and second generation application studies. These include: (1) multi-agency river basin planning; (2) corridor assessment and route location for highway location together with improvement of county-level planning decisions; (3) improving timber management practices; (4) enforcement of new state statutes; (5) county-wide open space preservation; (6) land value reappraisal relative to property tax equalization; and (7) optimizing agribusiness processing plant locations. Author

N76-17567* Washington Univ., Seattle.
DEVELOPMENT OF USER APPLICATIONS FOR EARTH RESOURCES SURVEY DATA IN URBAN AND REGIONAL PLANNING IN THE PUGET SOUND AREA
Frank V. Westerlund *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1769-1784 refs (For availability see N76-17552 08-43)
(DI-14-08-001-12864)
(L-17) CSCL 05A

User applications of remote sensing in Washington State are described. The first project created a multi-temporal land use/land cover data base for the environs of the Seattle-Tacoma International Airport, to serve planning and management operations of the Port of Seattle. The second is an on-going effort to develop a capability within the Puget Sound Governmental Conference, a council of governments (COG), to inventory and monitor land use within its four county jurisdiction. Developmental work has focused on refinement of land use/cover classification systems applicable at this regional scale and various levels of detail in relation to program requirements of the agency. Related research, refinement of manual methods, user training and approaches to technology transfer are discussed. Author

N76-17568* Alaska Univ., Fairbanks.
APPLICATION OF SATELLITE REMOTE-SENSING DATA TO LAND SELECTION AND MANAGEMENT
W. J. Stringer, J. M. Miller, A. E. Belon, L. H. Shapiro, and J. H. Anderson *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1785-1795 refs Sponsored in part by Dept. of Interior (For availability see N76-17552 08-43)
(Grant NGL-02-001-092)
(L-18) CSCL 05A

A pilot project conducted to demonstrate the utility and economy of satellite data in preparing thematic maps of a wilderness area emphasizing those resources of greatest interest to the potential owner is described. Vegetation maps delineating potential commercial timber and maps of suggested mineral prospecting areas of seven scattered regions were prepared by interpretation of LANDSAT images, coupled with a limited amount of ground truth. Images acquired both in winter and summer seasons were registered to township maps and used in making interpretations of the areal extent of commercial timber potentials. The amount of snow cover visible through the forest canopies was found to be a useful indicator of timber potentials. Identification was made of characteristic topographic features which are typical of flood plain deposits or of the well developed trellis drainage patterns which can indicate the strike of structural grain of underlying Cretaceous sedimentary rocks. The presence of igneous and mixed igneous and metamorphic rocks were indicated by combinations of spectral differences and anomalous interruptions of local radial drainage patterns. Author

N76-17569* Texas A&M Univ., College Station.
THREE EXAMPLES OF APPLIED REMOTE SENSING OF VEGETATION
J. W. Rouse, Jr., A. R. Benton, Jr., R. W. Toler, and R. H. Haas *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1797-1810 (For availability see N76-17552 08-43)
(Grant NGL-44-001-001)
(L-19) Avail: NTIS CSCL 08F

Cause studies in which remote sensing techniques were adapted to assist in the solution of particular problem situations in Texas involving vegetation are described. In each case, the final sensing technique developed for operational use by the concerned organizations employed photographic sensors which were optimized through studies of the spectral reflectance characteristics of the vegetation species and background conditions unique to the problem being considered. The three examples described are: (1) Assisting Aquatic Plant Monitoring and Control; (2) Improving Vegetation Utilization in Urban Planning; and (3) Enforcing the Quarantine of Diseased Crops. Author

N76-17570* American Association for the Advancement of Science, Washington, D.C.
INTERACTIVE MULTI-SPECTRAL ANALYSIS OF MORE THAN ONE SONRAI VILLAGE IN NIGER, WEST AFRICA
Priscilla Reining and Dwight D. Egbert (GE Co., Beltsville, Md.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1811-1821 refs (For availability see N76-17552 08-43)
(L-20) CSCL 08B

Use of LANDSAT data and an interaction system is considered for identifying and measuring small scale compact human settlements (villages) for demographic and anthropological studies. Because village components are not uniformly distributed within any one village, they apparently are multimodal, spectrally. Therefore, the functions of location and enumeration are kept separate. Measurement of a known village is compared with CCT response. Author

N76-17571* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PRESENT AND POTENTIAL LAND USE MAPPING IN MEXICO
Hector Garduno, Ricardo Garcia Lagos, and Fernando Garcia Simo *In its* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1823-1839 refs (For availability see N76-17552 08-43)
(L-22) CSCL 08B

The Mexican Water Plan (MWP) conducted studies of present and potential land use in Mexico using LANDSAT-1 satellite imagery. Present land use studies were carried out all over the country (197 million hectares); nine soil uses were mapped according to the first classification level recommended by the U.S. Geological Survey. Also 6.3 million hectares of land with advanced erosion were detected. Work was executed at a rate of 8 million hectares per month; reliability was 90% and the

cost of only 0.1 cents/hectare. The potential land use study was performed in 45 million hectares at a rate of 4 million hectares per month and at a cost of 0.33 cents/hectare. Soil units according to FAO classification were delineated scale 1:1 million; interpretative maps were also prepared dealing with potential agricultural productivity carrying capacity for cattle, water, erosion risk, and slope ranges. Author

N76-17572* Earth Satellite Corp., Washington, D.C.
LAND USE CLASSIFICATION IN BOLIVIA
Carlos E. Brockman (GEOBOL, La Paz, Bolivia) and William G. Brooner *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1841-1861 refs (For availability see N76-17552 08-43)
(L-23) CSCL 08B

The Bolivian LANDSAT Program is an integrated, multidisciplinary project designed to provide thematic analysis of LANDSAT, Skylab, and other remotely sensed data for natural resource management and development in Bolivia, is discussed. Among the first requirements in the program is the development of a legend, and appropriate methodologies, for the analysis and classification of present land use based on landscape cover. The land use legend for Bolivia consists of approximately 80 categories in a hierarchical organization which may be collapsed for generalization, or expanded for greater detail. The categories, and their definitions, provide for both a graphic and textual description of the complex and diverse landscapes found in Bolivia, and are designed for analysis from LANDSAT and other remotely sensed data at scales of 1:1,000,000 and 1:250,000. Procedures and example products developed are described and illustrated, for the systematic analysis and mapping of present land use for all of Bolivia. Author

N76-17573* Central Lab. for Geophotogrammetry and Remote Sensing, Munich (West Germany).
APPLICATION OF LANDSAT AND SKYLAB DATA FOR LAND USE MAPPING IN ITALY
J. Bodechtel, J. Nithack, G. DiBernardo, K. Hiller, F. Jaskolla, and A. Smolka *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1863-1886 ref (For availability see N76-17552 08-43)
(L-25) CSCL 08B

Utilizing LANDSAT and Skylab multispectral imagery of 1972 and 1973, a land use map of the mountainous regions of Italy was evaluated at a scale of 1:250,000. Seven level I categories were identified by conventional methods of photointerpretation. Images of multispectral scanner (MSS) bands 5 and 7, or equivalents were mainly used. Areas of less than 200 by 200 m were classified and standard procedures were established for interpretation of multispectral satellite imagery. Land use maps were produced for central and southern Europe indicating that the existing land use maps could be updated and optimized. The complexity of European land use patterns, the intensive morphology of young mountain ranges, and time-cost calculations are the reasons that the applied conventional techniques are superior to automatic evaluation. Author

N76-17574* Battelle Columbus Labs., Ohio.
THE SIGNIFICANCE OF THE SKYLAB ALTIMETER EXPERIMENT RESULTS AND POTENTIAL APPLICATIONS
A. G. Mourad, S. Gopalapillai, and M. Kuhner *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1887-1909 refs (For availability see N76-17552 08-43)
(M-1) CSCL 05B

The Skylab Altimeter Experiment has proven the capability of the altimeter for measurement of sea surface topography. The geometric determination of the geoid/mean sea level from satellite altimetry is a new approach having significant applications in many disciplines including geodesy and oceanography. A Generalized Least Squares Collocation Technique was developed for determination of the geoid from altimetry data. The technique solves for the altimetry geoid and determines one bias term for the combined effect of sea state, orbit, tides, geoid, and instrument error using sparse ground truth data. The influence of errors in orbit and a priori geoid values are discussed. Although the Skylab altimeter instrument accuracy is about + or - 1 m, significant results were obtained in identification of large geoidal features such as over the Puerto Rico trench. Comparison of the results of several passes shows that good agreement exists between the general slopes of the altimeter geoid and the ground truth, and that the altimeter appears to be capable of providing more details than are now available with best known geoids. The altimetry geoidal profiles show excellent correlations with bathymetry and gravity. Potential applications of altimetry results to geodesy, oceanography, and geophysics are discussed. Author

N76-17575* National Oceanic and Atmospheric Administration, Miami, Fla. Sea-Air Interaction Lab.
A COMPARISON OF SKYLAB S-193 AND AIRCRAFT VIEWS OF SURFACE ROUGHNESS AND A LOOK TOWARD SEASAT
Duncan Ross *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1911-1936 refs (For availability see N76-17552 08-43)
(M-2) CSCL 08B

An extensive aircraft underflight program was conducted along the Skylab groundpath for the purpose of documenting wind, wave, and atmospheric conditions affecting the amplitude of the active and passive microwave signatures. The S-193 microwave system senses a roughness parameter at the ocean surface that is proportional to the surface windspeed. The aircraft program is described, and some comparisons of satellite and aircraft results are presented. The principal result of the comparison of active radar is that direct inferences of the surface windspeed are possible, but subject to considerable scatter, and that this scatter appears to be due to interaction between long gravity and short Bragg waves and backscatter due to rain as well as errors in correcting for azimuth dependence. An unforeseen opportunity to observe a Pacific hurricane by both Skylab and NOAA aircraft has contributed to the development of a simplified wave forecasting scheme applicable to hurricanes, and more general conditions, which combines the better qualities of both spectral and height/period forecasting techniques. Horizontal polarization data obtained by the aircraft in Hurricane Ava, and in other experiments, which led to this development are presented.
Author

N76-17576* Kansas Univ. Center for Research, Inc., Lawrence.
SKYLAB S-193 RADSCAT MICROWAVE MEASUREMENTS OF SEA SURFACE WINDS
R. K. Moore, A. K. Fung, J. Young, J. Claassen, H. Chan, M. Afarani, W. J. Pierson, V. J. Cardone, J. Hayes, W. Spring et al *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1937-1952 refs Prepared in cooperation with City Univ. of New York (For availability see N76-17552 08-43)
(M-3) CSCL 04B

The S-193 Radscat made extensive measurements of many sea conditions. Measurements were taken in a tropical hurricane (Ava), a tropical storm (Christine), and in portions of extratropical cyclones. Approximately 200 scans of ocean data at 105 kilometer spacings were taken during the first two Skylab missions and another 200 during the final mission when the characteristics of the measurements changed due to damage of the antenna. Backscatter with four transmit/receive polarization combinations and emissions with horizontal and vertical receive polarizations were measured. Other surface parameters investigated for correlation with the measurements included sea temperature, air/sea temperature difference, and gravity-wave spectrum. Methods were developed to correct the microwave measurements for atmospheric effects. The radiometric data were corrected accurately for clear sky and light cloud conditions only. The radiometer measurements were used to recover the surface scattering characteristics for all atmospheric conditions excluding rain. The radiometer measurements also detected the presence of rain which signaled when the scattering measurement should not be used for surface wind estimation. Regression analysis was used to determine empirically the relation between surface parameters and the microwave measurements, after correction for atmospheric effects. Results indicate a relationship approaching square-law at 50 deg between differential scattering coefficient and wind speed with horizontally polarized scattering data showing slightly more sensitivity to wind speed than vertically polarized data. Author

N76-17577* Science Applications, Inc., La Jolla, Calif.
A PROCEDURE FOR ESTIMATION OF SEA-SURFACE TEMPERATURE FROM REMOTE MEASUREMENTS IN THE 10 - 13 MICROMETERS SPECTRAL REGION
David C. Anding *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1953-1972 refs (For availability see N76-17552 08-43)
(M-4) CSCL 04B

The feasibility is demonstrated of a procedure for the remote measurement of sea-surface temperature which inherently corrects for the effect of the intervening atmosphere without recourse to climatological data. The procedure relies upon the near-linear differential absorption properties of the infrared window region between 10 and 13 micrometers and requires radiometric measurements in a minimum of two spectral intervals within the infrared window which have a significant difference in absorption coefficient. The procedure was applied to Nimbus 4 infrared interferometer spectrometer (IRIS) data and to Skylab EREP S191 spectrometer data, and it is demonstrated that atmospheric effects on the observed brightness temperature can be reduced to less than 1.0 Kelvin. Author

N76-17578* National Environmental Satellite Service, Suitland, Md.
SURFACE CIRCULATION IN THE GREAT LAKES AS OBSERVED BY LANDSAT-1 AUGUST 1972 - DECEMBER 1973: SOUTHERN LAKE MICHIGAN
Harry G. Stumpf and Alan E. Strong *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1973-1988 refs (For availability see N76-17552 08-43)
(M-5) CSCL 04B

The surface current circulation patterns of southern Lake Michigan were charted for all cardinal and subcardinal wind directions, employing LANDSAT-1 observations of the distribution of natural tracing material borne in the surface waters. These colorants consist chiefly of river discharges composed of suspended sediments, pollutants, and algae; extensive chemical precipitations proved valuable for areas farther from shore. Comparison of the satellite-derived surface current charts with previous theoretical and empirical studies shows good agreement. Author

N76-17579* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OCEAN COLOR IMAGERY: COASTAL ZONE COLOR SCANNER
Warren A. Hovis *In its* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1989-2003 (For availability see N76-17552 08-43)
(M-6) CSCL 14E

Investigations into the feasibility of sensing ocean color from high altitude for determination of chlorophyll and sediment distributions were carried out using sensors on NASA aircraft, coordinated with surface measurements carried out by oceanographic vessels. Spectrometer measurements in 1971 and 1972 led to development of an imaging sensor now flying on a NASA U-2 and the Coastal Zone Color Scanner to fly on Nimbus G in 1978. Results of the U-2 effort show the imaging sensor to be of great value in sensing pollutants in the ocean. Author

N76-17580* Delaware Univ., Newark. Coll. of Marine Studies.
SKYLAB INVESTIGATION OF THE UPWELLING OFF THE NORTHWEST COAST OF AFRICA
Karl-Heinz Szekielda, Dennis J. Suszkowski, and Paul S. Tabor *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2005-2021 refs (For availability see N76-17552 08-43)
(M-7) CSCL 08C

The upwelling off the NW coast of Africa in the vicinity of Cape Blanc was studied in February - March 1974 from aircraft and in September 1973 from Skylab. The aircraft study was designed to determine the effectiveness of a differential radiometer in quantifying surface chlorophyll concentrations. Photographic images of the S190A Multispectral Camera and the S190B Earth Terrain Camera from Skylab were used to study distributional patterns of suspended material and to locate ocean color boundaries. The thermal channel of the S192 Multispectral Scanner was used to map sea-surface temperature distributions offshore of Cape Blanc. Correlating ocean color changes with temperature gradients is an effective method of qualitatively estimating biological productivity in the upwelling region off Africa. Author

N76-17581* National Marine Fisheries Service, Bay Saint Louis, Miss.
THE FEASIBILITY OF UTILIZING REMOTELY SENSED DATA TO ASSESS AND MONITOR OCEANIC GAMEFISH
Kenneth J. Savastano and Thomas D. Leming *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2023-2062 refs (For availability see N76-17552 08-43)
(M-8) CSCL 08A

An investigation was conducted to establish the feasibility of utilizing remotely sensed data acquired from aircraft and satellite platforms to provide information concerning the distribution and abundance of oceanic gamefish. The data from the test area was jointly acquired by NASA, the Navy, the Air Force and NOAA/NMFS elements and private and professional fishermen in the northeastern Gulf of Mexico. The data collected has made it possible to identify fisheries significant environmental parameters for white marlin. Prediction models, based on catch data and surface truth information, were developed and demonstrated a potential for significantly reducing search by identifying areas that have a high probability of productivity. Three of the parameters utilized by the models, chlorophyll-a, sea surface temperature, and turbidity were inferred from aircraft sensor data and were tested. Effective use of Skylab data was inhibited by cloud cover and delayed delivery. Initial efforts toward establishing the feasibility of utilizing remotely sensed data to assess and monitor the distribution of oceanic gamefish has successfully identified fisheries significant oceanographic parameters and demonstrated the capability of remotely measuring most of the parameters. Author

N76-17582* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT DIGITAL DATA PROCESSING: A NEAR REAL-TIME APPLICATION
John L. Barker, Charles Bohn, Locke Stuart, and John Hill (Texas A/M Univ., College Station) *In its* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2063-2073 (For availability see N76-17552 08-43)
(M-9) CSCL 05B

An application of rapid generation of classed digital images from LANDSAT-1 was demonstrated and its feasibility evaluated by NASA in conjunction with the Environmental Protection Agency (EPA), Texas A and M University (TAMU), and the Cousteau Society. The primary purpose was to show that satellite data could be processed and transmitted to the Calypso, which was used as a research vessel, in time for use in directing it to specific locations of possible plankton upwellings, sediment, or other anomalies in the coastal water areas along the Gulf of Mexico. Author

N76-17583* Environmental Research Inst. of Michigan, Ann Arbor.
NEARSHORE COASTAL MAPPING
Fabian C. Polcyn and David R. Lyzenga *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2075-2086 refs (For availability see N76-17552 08-43)
(M-10) CSCL 08B

Two test sites of different water quality and bottom topography were used to test for maximum water depth penetration using the Skylab S-192 MSS for measurement of nearshore coastal bathymetry. Sites under investigation lie along the Lake Michigan coastline where littoral transport acts to erode sand bluffs and endangers developments along 1,200 miles of shore, and on the west coast of Puerto Rico where unreliable shoal location and depth information constitutes a safety hazard to navigation. The S-192 and S-190A and B provide data on underwater features because of water transparency in the blue/green portion of the spectrum. Depth of 20 meters were measured with the S-192 in the Puerto Rico test site. The S-190B photography with its

improved spatial resolution clearly delineates the triple sand bar topography in the Lake Michigan test site. Several processing techniques were employed to test for maximum depth measurement with least error. The results are useful for helping to determine an optimum spectral bandwidth for future space sensors that will increase depth measurements for different water attenuation conditions where a bottom reflection is detectable. Author

N76-17584* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
QUANTITATIVE SUSPENDED SEDIMENT MAPPING USING AIRCRAFT REMOTELY SENSED MULTISPECTRAL DATA
Robert W. Johnson *In its* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2087-2098 refs (For availability see N76-17552 08-43)
(M-11) CSCL 08B

Suspended sediment is an important environmental parameter for monitoring water quality, water movement, and land use. Quantitative suspended sediment determinations were made from analysis of aircraft remotely sensed multispectral digital data. A statistical analysis and derived regression equation were used to determine and plot quantitative suspended sediment concentration contours in the tidal James River, Virginia, on May 28, 1974. From the analysis, a single band, Band 8 (0.70-0.74 microns), was adequate for determining suspended sediment concentrations. A correlation coefficient of 0.89 was obtained with a mean inaccuracy of 23.5 percent for suspended sediment concentrations up to about 50 mg/l. Other water quality parameters - secchi disc depth and chlorophyll - also had high correlations with the remotely sensed data. Particle size distribution had only a fair correlation with the remotely sensed data. Author

N76-17585* National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
REMOTE SENSING OF SALINITY
Gary C. Thomann *In its* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2099-2126 refs (For availability see N76-17552 08-43)
(M-12) CSCL 08J

The complex dielectric constant of sea water is a function of salinity at 21 cm wavelength, and sea water salinity can be determined by a measurement of emissivity at 21 cm along with a measurement of thermodynamic temperature. Three aircraft and one helicopter experiments using two different 21 cm radiometers were conducted under different salinity and temperature conditions. Single or multiple ground truth measurements were used to calibrate the data in each experiment. It is inferred from these experiments that accuracies of 1 to 2%/OO are possible with a single surface calibration point necessary only every two hours if the following conditions are met--water temperatures above 20 C, salinities above 10%/OO, and level plane flight. More frequent calibration, constraint of the aircraft's orientation to the same as it was during calibration, and two point calibration (at a high and low salinity level) rather than single point calibration may give even better accuracies in some instances. Author

N76-17586* National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
AUTOMATIC INTERFACE MEASUREMENT AND ANALYSIS
Kenneth H. Faller *In its* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2127-2146 refs (For availability see N76-17552 08-43)
(M-13) CSCL 05B

A technique for detecting and measuring the interface between two categories in classified scanner data is described together with two application demonstrations. Measurements were found to be accurate to 1.5% root mean square error on features of known length while comparison of measurements made using the technique on LANDSAT data to opisometer measurements on 1:24,000 scale maps shows excellent agreement. Application of the technique to two frames of LANDSAT data classified using a two channel, two class classifier resulted in a computation of 64 km annual decrease in shoreline length. The tidal shoreline of a portion of Alabama was measured using LANDSAT data. Based on the measurement of this portion, the total tidal shoreline length of Alabama is estimated to be 1313 kilometers. Author

N76-17587* National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
THE MAPPING OF MARSH VEGETATION USING AIRCRAFT MULTISPECTRAL SCANNER DATA
M. Kristine Butera *In its* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2147-2166 refs (For availability see N76-17552 08-43)
(M-14) CSCL 08F

A test was conducted to determine if salinity regimes in coastal marshland could be mapped and monitored by the identification and classification of marsh vegetative species from aircraft multispectral scanner data. The data was acquired at 6.1 km (20,000 ft.) on October 2, 1974, over a test area in the coastal marshland of southern Louisiana including fresh, intermediate, brackish, and saline zones. The data was classified by vegetational species using a supervised, spectral pattern recognition procedure. Accuracies of training sites ranged from 67% to 96%. Marsh zones based on free soil water salinity were determined from the species classification to demonstrate a practical use for mapping marsh vegetation. Author

N76-17588*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 1-D: WATER RESOURCES First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data
Jun. 1975 527 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-A N76-17469; Vol. 1-B N76-17501; Vol. 1-C N76-17552; Vol. 3 N76-17613; Original contains color imagery. Original NASA photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(NASA-TM-X-58168-Vol-1-D; JSC-09930-Vol-1-D) Avail: NTIS HC $7.25 CSCL 05B

Conference papers on water resources and management are summarized. Summaries cover land use, flood control and prediction, watersheds and the effects of snow melt, soil moisture content, and the usefulness of satellite remote sensors in detecting ground and surface water. For individual titles, see N76-17589 through N76-17612.

N76-17589* Wyoming Univ., Laramie. Dept. of Geology.
THE USE OF SKYLAB AND LANDSAT IN A GEOHYDROLOGICAL STUDY OF THE PALEOZOIC SECTION, WEST-CENTRAL BIGHORN MOUNTAINS, WYOMING
Barbara J. Tomes *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2167-2182 refs (For availability see N76-17588 08-43)
(W-1) CSCL 08H

Sites of geologic structures were identified using Skylab and LANDSAT imagery, and their relationships to ground water recharge and discharge were studied. The study area lies along the western slope of the Bighorn Mountains. Runoff flowing from the Precambrian core of the Bighorn Mountains sinks as it flows over outcrops of the Bighorn dolomite. A comparison of photo-geologic maps prepared from Skylab and LANDSAT imagery and a geologic map compiled by Darton (1906) illustrates that photomapping, by itself, cannot supply adequate detail but can supplement reconnaissance mapping. Lineation maps were compiled from LANDSAT and Skylab images and compared to similar maps compiled by other investigators. Author

N76-17590* Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (West Germany).
HYDROGEOLOGICAL INVESTIGATIONS IN THE PAMPA OF ARGENTINA
Wolfgang Kruck and Wilfried Kantor *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2183-2197 refs (For availability see N76-17588 08-43)
(W-2) CSCL 08H

In large areas of the Argentinian Pampa the salinization of ground water creates water supply difficulties. Investigations of satellite imagery (Landsat-1 and Skylab) which were based on an extensive ground survey revealed that differences in the vegetation cover are closely related to depth and salinity of ground water. Narrow elongated depressions called bajos are

often the only indication of fresh ground water. They can be easily detected on the imagery. Due to their high resolution, Skylab photos even allow a quantitative estimation of fresh ground water situated below the bajos. In general however Landsat-1 imagery sufficed for evaluation. In the area of the Rio Tercero a fossil drainage pattern was discovered and in Corrientes province, soil types could be discriminated and compared to the Soil Map of the World. Author

N76-17591* California Univ., Santa Barbara. Geography Remote Sensing Unit.

URBAN LAND USE: REMOTE SENSING OF GROUND-BASIN PERMEABILITY

Larry R. Tinney, John R. Jensen, and John E. Estes *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2199-2206 refs (For availability see N76-17588 08-43)

(W-4) CSCL 08B

A remote sensing analysis of the amount and type of permeable and impermeable surfaces overlying an urban recharge basin is discussed. An effective methodology for accurately generating this data as input to a safe yield study is detailed and compared to more conventional alternative approaches. The amount of area inventoried, approximately 10 sq. miles, should provide a reliable base against which automatic pattern recognition algorithms, currently under investigation for this task, can be evaluated. If successful, such approaches can significantly reduce the time and effort involved in obtaining permeability data, an important aspect of urban hydrology dynamics. Author

N76-17592* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MICROWAVE REMOTE SENSING OF SOIL MOISTURE

Fawwaz T. Ulaby (Kansas Univ., Lawrence), Percy P. Batlivala (Kansas Univ., Lawrence), Josef Cihlar (Kansas Univ., Lawrence), and Thomas Schmugge *In its* NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2207-2232 refs (For availability see N76-17588 08-43)

(W-5) CSCL 08M

The potential application of microwave remote sensing devices in estimating soil moisture content over extended areas was examined. Experimental measurements involving both active and passive microwave sensors acquired from a variety of platforms are presented. Author

N76-17593* Kansas Univ., Lawrence.

SOIL MOISTURE DETECTION FROM SKYLAB

Joe R. Eagleman and Wen C. Lin *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2233-2241 refs (For availability see N76-17588 08-43)

(W-6) CSCL 08M

An investigation was designed for the Skylab satellite to determine the feasibility of remote sensing of the soil moisture content of the surface from various microwave sensors. Skylab data for the experiment were collected during passes 5, 10, 16, and 38 across the two test sites selected in eastern Kansas and western Texas. Pass 38 covered both test sites giving five data sets for the analysis. As Skylab data were being taken the moisture content of the soil was sampled by ground crews for each 2.5 centimeter depth from the surface to 15 centimeters at interval of about six kilometers along two different routes along the test sites. This resulted in a total of 2250 soil moisture samples corresponding to different locations and six different depths. Skylab data were collected by passive microwave radiometers at wavelengths of 2.1 and 21 centimeters by the S193 and S194 microwave sensors. An active microwave system also collected scatterometer data at a wavelength of 2.1 centimeters. The analysis of microwave data has revealed that the longer wavelength L-Band passive radiometer gives the best correlation with soil moisture content of the upper 2.5 centimeter depth of soil. Author

N76-17594* Oklahoma Univ., Norman.

THE CORRELATION OF SKYLAB L-BAND BRIGHTNESS TEMPERATURES WITH ANTECEDENT PRECIPITATION

Marshall J. McFarland *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2243-2252 refs (For availability see N76-17588 08-43) (Contract NAS9-13360; Proj. 582)

(W-7) CSCL 08M

The S194 L-band radiometer flown on the Skylab mission measured terrestrial radiation at the microwave wavelength of 21.4 cm. The terrain emissivity at this wavelength is strongly dependent on the soil moisture content, which can be inferred from antecedent precipitation. For the Skylab data acquisition pass from the Oklahoma panhandle to southeastern Texas on 11 June 1973, the S194 brightness temperatures are highly correlated with antecedent precipitation from the preceding eleven day period, but very little correlation was apparent for the preceding five day period. The correlation coefficient between the averaged antecedent precipitation index values and the corresponding S194 brightness temperatures between 230 K and 270 K, the region of apparent response to soil moisture in the data, was -0.97. The equation of the linear least squares line fitted to the data was: API (cm) = 31.99 -0.114 TB (K), where API is the antecedent precipitation index and TB is the S194 brightness temperature. Author

N76-17595* Texas Univ., Austin. Dept. of Geological Sciences.

FLOOD HAZARD STUDIES IN CENTRAL TEXAS USING ORBITAL AND SUBORBITAL REMOTE SENSING MACHINERY

Victor R. Baker, Robert K. Holz, and Peter C. Patton *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2253-2294 refs (For availability see N76-17588 08-43)

(Contract NAS9-13312)

(W-8) CSCL 08H

Central Texas is subject to infrequent, unusually intense rainstorms which cause extremely rapid runoff from drainage basins developed on the deeply dissected limestone and marl bedrock of the Edwards Plateau. One approach to flood hazard evaluation in this area is a parametric model relating flood hydrograph characteristics to quantitative geomorphic properties of the drainage basins. The preliminary model uses multiple regression techniques to predict potential peak flood discharge from basin magnitude, drainage density, and ruggedness number. After mapping small catchment networks from remote sensing imagery, input data for the model are generated by network digitization and analysis by a computer assisted routine of watershed analysis. The study evaluated the network resolution capabilities of the following data formats: (1) large-scale (1:24,000) topographic maps, employing Strahler's 'method of v's,' (2) standard low altitude black and white aerial photography (1:13,000 and 1:20,000 scales), (3) NASA - generated aerial infrared photography at scales ranging from 1:48,000 to 1:123,000, and (4) Skylab Earth Resources Experiment Package S-190A and S-190B sensors (1:750,000 and 1:500,000 respectively). Author

N76-17596* Centro Interamericano de Fotointerpretacion, Bogota (Colombia).

AN INUNDATION STUDY OF THE LOWER MAGDALENA-CAUCA RIVER BASIN

Edward Vanes, Hernan Gomez, and Robert Soeters *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2295-2297 (For availability see N76-17588 08-43)

(W-9) CSCL 08H

Annual floodings affect about 35,000 sq km of the Lower Magdalena-Cauca River Basin in the northern part of Colombia. Efforts made to determine the effects of inundation extension and complex factors involved in the flooding problem are reported. An integrated survey was made of the entire river basin with the object of land reclamation in the lower part and determining the effects of inundation extension and other complex factors on flooding. Modern remote sensing techniques were for the study. Author

N76-17597* Colorado State Univ., Fort Collins.

REMOTE SENSING OF MISSISSIPPI RIVER CHARACTERISTICS

J. F. Ruff, M. M. Skinner (Corps of Engr., Vicksburg, Miss.), B. R. Winkley, D. B. Simons, and D. E. Dorratcague (CH2M Hill)

In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2299-2315 refs (For availability see N76-17588 08-43)
(W-10) CSCL 08H

A data collection program initiated by the Vicksburg District, to develop a workable knowledge of the principles relating to the transport of water and sediment to gain a better understanding of the Mississippi River characteristics is introduced. Aerial photographs and thermal infrared imagery were collected over two test reaches at low and high water stages. Qualitative interpretation of the data relates to the river characteristics such as flow patterns, relative velocities, sediment concentration distribution, water-depth effects, and effects of man made structures. Ground truth information is correlated with the remotely sensed data. Author

N76-17598* Wisconsin Univ., Madison.
APPLICATION OF THERMAL SCANNING TO THE STUDY OF TRANSVERSE MIXING IN RIVERS
J. Wayland Eheart *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2317-2324 ref (For availability see N76-17588 08-43)
(W-11) CSCL 08H

Remote sensing has shown itself to be a valuable research tool in the study of transverse mixing in rivers. It is desirable, for a number of reasons, to study and predict the two-dimensional movement of pollutants in the region just downstream of a pollutant discharge point. While many of the more common pollutants do not exhibit a spectral signature, it was shown that the temperature difference between the pollutant and the receiving water could be successfully exploited by applying a mathematical model of mass transport processes to heat transport, and testing and calibrating it with thermal scanning data. Author

N76-17599* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UTILIZATION OF LANDSAT DATA FOR WATER QUALITY SURVEYS IN THE CHOPTANK RIVER
James M. Johnson (GE, Beltsville, Md.), Philip Cressy, and William C. Dallam (GE, Beltsville, Md.) *In its* NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2325-2350 refs (For availability see N76-17588 08-43)
(W-12) CSCL 08H

Computer processing of LANDSAT-1 multispectral digital data demonstrated the applicability of remotely sensed data to water quality survey in the Choptank River. Water classes derived by automated analysis correlate to river nuisance levels of chlorophyll a and sediment loading as defined by the Maryland Department of Water Resources and the U.S. Corps of Engineers. Results indicate that an increase in chlorophyll a concentration corresponds, relative to MSS 5, to decreases in 4 and increases in 6 relative to the trends with increasing sediment load. It appears that for the purpose of water quality analysis, under favorable atmospheric conditions, only MSS 4, 5 and 6 are necessary. Author

N76-17600* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HYDROLOGIC LAND USE CLASSIFICATION OF THE PATUXENT RIVER WATERSHED USING REMOTELY SENSED DATA
William C. Dallam (GE, Beltsville), Albert Rango, and Lurie Shima *In its* NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2351-2364 refs (For availability see N76-17588 08-43)
(W-13) CSCL 08H

The Patuxent River Watershed is located in central Maryland between Baltimore and Washington, D.C. and is approximately 2330 sq km in area and 175 km long. This region is now at a critical point because of major concerns such as water management and quality, flooding and land use within the watershed. Data from the NASA-directed LANDSAT and Earth Resources Aircraft Programs were used to provide a new dimension in information collection and processing for the management of watersheds. Digital data from LANDSAT-1 were analyzed along with selected IR photography from U-2 flight number 74-060B taken 28 April 1974, which was digitized in three channels. Processing of the data was accomplished using a multispectral analysis system. Land use themes consisting of surface water, wetlands, forest, residential, cropland/pasture, urban, and extractive were developed and delineated through the watershed. Area measurements of watershed themes were obtained and will serve as a calibration input to a deterministic hydrologic model on a sub-watershed. Using the derived residential and urban theme areas from LANDSAT an estimated basin imperviousness was also calculated. Thematic maps were produced at 1:62,500 scale. Floodprone areas were also classified and delineated at a scale of 1:24,000. Comparison with standard floodprone area maps at the same scale have indicated a few areas of discrepancy. Such information can be used for updating or checking floodprone area boundaries as well as monitoring changes in floodplain areas. Author

N76-17601* Maryland Univ., College Park. Dept. of Civil Engineering.
LAND USE CLASSIFICATION FOR HYDROLOGIC MODELS USING INTERACTIVE MACHINE CLASSIFICATION OF LANDSAT DATA
Thomas J. Jackson, Robert M. Ragan, and Richard H. McCuen *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2365-2378 refs (For availability see N76-17588 08-43)
(W-14) CSCL 08B

A study was developed to investigate the use of computer aided analysis of LANDSAT multispectral data in estimating percent of imperviousness and associated land uses needed in urban hydrologic modeling. An interactive computer was used to delineate seven land use classifications in the 342 sq. km. Maryland portion of the Anacostia River Basin from LANDSAT data. These results compared favorably with those of an earlier study which obtained the same information through analysis of aerial photographs having a scale of 1:4800. Approximately 94 man days were required to complete the land use analysis using the aerial photographs while less than three man days were required to accomplish similar tasks using the LANDSAT data. Author

N76-17602* Texas A&M Univ., College Station.
REMOTE SENSING TECHNIQUES FOR PREDICTION OF WATERSHED RUNOFF
Bruce J. Blanchard *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2379-2406 refs Sponsored in part by NASA and USDA (For availability see N76-17588 08-43)
(W-15) CSCL 08H

Hydrologic parameters of watersheds for use in mathematical models and as design criteria for flood detention structures are sometimes difficult to quantify using conventional measuring systems. The advent of remote sensing devices developed in the past decade offers the possibility that watershed characteristics such as vegetative cover, soils, soil moisture, etc., may be quantified rapidly and economically. Experiments with visible and near infrared data from the LANDSAT-1 multispectral scanner indicate a simple technique for calibration of runoff equation coefficients is feasible. The technique was tested on 10 watersheds in the Chickasha area and test results show more accurate runoff coefficients were obtained than with conventional methods. The technique worked equally as well using a dry fall scene. The runoff equation coefficients were then predicted for 22 subwatersheds with flood detention structures. Predicted values were again more accurate than coefficients produced by conventional methous. Author

N76-17603* Geological Survey, Tampa, Fla. Water Resources Div.
WATER-MANAGEMENT MODEL IN FLORIDA FROM LANDSAT-1 DATA
A. L. Higer, E. H. Cordes, A. E. Coker (Bendix Corp., Ann Arbor, Mich.), and R. H. Rogers *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2407-2442 refs (For availability see N76-17588 08-43)
(W-16) CSCL 08H

A prototype data acquisition and dissemination network and its effectiveness in improving and/or solving hydrologic problems in southern Florida are evaluated. The network utilized LANDSAT MSS imagery and in situ monitoring by LANDSAT-DCS Results show water level and rain fall measurements were collected

and disseminated in less than two hours, a significant improvement over conventional methods which took up to two months. Improved network performance has also aided the development of water budgets and water distribution to the people, funa, and flora in the area. Imagery from LANDSAT was also found to enhance the utility of ground measurements. Author

N76-17604* Corps of Engineers, Waltham, Mass. New England Div.

THE USE OF LANDSAT DCS AND IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION

Saul Cooper, Paul Bock (Conn. Univ., Storrs), Joseph Horowitz, and Dennis Foran (Conn. Univ., Storrs) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2443-2522 refs (For availability see N76-17588 08-43)

(W-17) CSCL 08H

Experiments by the New England Division (NED), Corps of Engineers with LANDSAT-1 data collection and imaging systems are reported. Data cover the future usefulness of data products received from satellites such as LANDSAT in the day to day operation of NED water resources systems used to control floods. Author

N76-17605* Texas Water Development Board, Austin.

THE APPLICATION OF REMOTE SENSING TECHNOLOGY TO THE INVENTORY OF PLAYA LAKES IN THE HIGH PLAINS OF TEXAS

A. Wayne Wyatt, Michael L. Ellis, and Ann E. Bell *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2523-2530 refs (For availability see N76-17588 08-43)

(W-18) CSCL 08H

The feasibility of using LANDSAT digital data to inventory the playa lakes of the High Plains region of Texas was investigated. The project will use the detection and mapping (DAM) package developed at NASA-Johnson Space Center. The economy of the High Plains region is dependent on ground water for irrigation and the Ogallala aquifer is being depleted faster than it is being recharged. The playa lakes represent a potential source of artificial recharge for the aquifer and an inventory is the first step in that direction. Author

N76-17606* California State Dept. of Water Resources, Sacramento.

REMOTE SENSING APPLICATIONS IN WATER RESOURCES MANAGEMENT BY THE CALIFORNIA DEPARTMENT OF WATER RESOURCES

Barry Brown *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2531-2560 (For availability see N76-17588 08-43)

(W-19) CSCL 08H

The possibility of applying imagery from high altitude aircraft and satellites sensors to water management in California was evaluated. Results from seven applications studies comparing the costs of using high altitude imagery for various purposes to the costs of using conventional data sources, reveal the high altitude imagery to be more cost effective in six cases and equal to conventional data sources in one case. These results also reveal that the imagery provides a level of quality not generally achievable with uncorrected conventional imagery. Although satellite application studies are not yet complete, preliminary results indicate that some definite possibilities exist for employing satellite imagery on an operational basis within the next few years. Author

N76-17607* South Dakota State Univ., Brookings. Remote Sensing Inst.

EVALUATION OF THERMAL X/5-DETECTOR SKYLAB S-192 DATA FOR ESTIMATING EVAPOTRANSPIRATION AND THERMAL PROPERTIES OF SOILS FOR IRRIGATION MANAGEMENT

D. G. Moore, M. L. Horton, M. J. Russell, and V. I. Myers *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2561-2583 refs (For availability see N76-17588 08-43)

(Contract NAS9-13337)

(W-21; SDSU-RSI-J-75-03) CSCL 08M

An energy budget approach to evaluating the SKYLAB X/5-detector S-192 data for prediction of soil moisture and evapotranspiration rate was pursued. A test site which included both irrigated and dryland agriculture in Southern Texas was selected for the SL-4 SKYLAB mission. Both vegetated and fallow fields were included. Data for a multistage analysis including ground, NC-130B aircraft, RB-57F aircraft, and SKYLAB altitudes were collected. The ground data included such measurements as gravimetric soil moisture, percent of the ground covered by green vegetation, soil texture, net radiation, soil temperature gradients, surface emittance, soil heat flux, air temperature and humidity gradients, and cultural practices. Ground data were used to characterize energy budgets and to evaluate the utility of an energy budget approach for determining soil moisture differences among twelve specific agricultural fields. Author

N76-17608* California Univ., Santa Barbara. Geography Remote Sensing Unit.

REMOTE SENSING INPUTS TO WATER DEMAND MODELING

John E. Estes, John R. Jensen, Larry R. Tinney, and Michael Rector (Kern County Water Agency) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2585-2620 refs (For availability see N76-17588 08-43)

(Grant NGL-05-003-404)

(W-22) CSCL 08H

In an attempt to determine the ability of remote sensing techniques to economically generate data required by water demand models, the Geography Remote Sensing Unit, in conjunction with the Kern County Water Agency of California, developed an analysis model. As a result it was determined that agricultural cropland inventories utilizing both high altitude photography and LANDSAT imagery can be conducted cost effectively. In addition, by using average irrigation application rates in conjunction with cropland data, estimates of agricultural water demand can be generated. However, more accurate estimates are possible if crop type, acreage, and crop specific application rates are employed. An analysis of the effect of saline-alkali soils on water demand in the study area is also examined. Finally, reference is made to the detection and delineation of water tables that are perched near the surface by semi-permeable clay layers. Soil salinity prediction, automated crop identification on a by-field basis, and a potential input to the determination of zones of equal benefit taxation are briefly touched upon. Author

N76-17609* California Univ., Berkeley.

AREAL EXTENT OF SNOW ESTIMATION IN THE NORTHERN SIERRA NEVADA MOUNTAINS USING LANDSAT-1 IMAGERY

Edwin F. Katibah *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2621-2641 refs (For availability see N76-17588 08-43)

(Grant NGL-05-003-404)

(W-23) CSCL 08F

Quantification of the surface area of snow covering watersheds is believed to be a useful parameter in estimating snow water content for inclusion in water runoff prediction equations. An operational manual interpretation technique which allows fast and accurate estimates to be made of the areal extent of snow parameter using LANDSAT-1 imagery is documented. The analysis procedures, the statistical results, and the associated costs of this research are presented. Author

N76-17610* Environmental Research and Technology, Inc., Concord, Mass.

SNOW SURVEY FROM SPACE, WITH EMPHASIS ON THE RESULTS OF THE ANALYSIS OF SKYLAB EREP S192 MULTISPECTRAL SCANNER DATA

James C. Barnes and Michael D. Smallwood *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2643-2659 refs (For availability see N76-17588 08-43)

(Contract NAS9-13305)

(W-24) CSCL 08L

The Skylab EREP S192 multispectral scanner data have provided an opportunity to examine the reflectance characteristics

of snow cover in several spectral bands extending from the visible into the near infrared spectral region to about 2 microns. The analysis of the S192 imagery and digital tape data from five EREP passes, two from the SL-2 mission and three from the SL-4 mission, indicates a sharp drop in reflectance of snow in the near infrared, with snow becoming essentially nonreflective in Bands 11 (1.55-1.75 microns) and 12 (2.10-2.35 microns). The results are in good agreement with the results of laboratory experiments. Two potential applications to snow mapping of measurements in the near infrared spectral region are possible: (1) the use of a near infrared band in conjunction with a visible band to distinguish automatically between snow and water droplet clouds, and (2) the use of one or more near infrared bands to detect areas of melting snow. Author

N76-17611* National Environmental Satellite Service, Suitland, Md.

FACTORS AFFECTING SNOW ASSESSMENT FROM LANDSAT DATA

David F. McGinnis, Jr., Michael C. McMillan, and Donald R. Wiesnet *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2661-2668 refs (For availability see N76-17588 08-43)

(W-25) CSCL 08L

Problems associated with using LANDSAT as a snow monitoring satellite are studied. Data cover problems of slop hinderance in thematic mapping of snow and detection of snow in forested areas. It was concluded that if detector saturation threshold is raised and the upper spectral limit of the MSS is extended, snow extent mapping will be improved along with the likelihood of monitoring some aspects of the physical condition of snow pack. E.H.W.

N76-17612* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OPERATIONAL WATER MANAGEMENT APPLICATIONS OF SNOWCOVERED AREA OBSERVATIONS

Albert Rango, Vincent V. Salomonson, and James L. Foster (Md. Univ., College Park) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D, Jun. 1975 p 2669-2685 refs (For availability see N76-17588 08-43)

(W-26) CSCL 08L

An effort was made to evaluate the utility of satellite snowcover observations for seasonal streamflow prediction. On a representative, large watershed(10 to the 5th power to 10 to the sixth power sq km) it was found, based on six years of data, that meteorological satellite observations of snow cover early in the snowmelt season exhibit a relationship to seasonal runoff having a statistically significant coefficient of determination of 0.92. Analyses of LANDSAT-1 snow-cover observations over the Wind River Mountains of Wyoming reveals that for areas with infrequent cloud cover the extent of snowcover and its change with time can be monitored on watersheds as small as 10 sq km in areal extent. The change in the snow cover with time as observed from LANDSAT-1 is found to reflect major differences in seasonal runoff from high altitude (mean altitude > 3 km) and low altitude (< 3 km) watersheds. There are quantitative indications that LANDSAT observations over small watersheds could be used in a manner similar to that employed for meteorological satellite observations to relate the percent of a basin snowcovered on a given data to seasonal runoff. Author

N76-17613*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 3: SUMMARY REPORTS First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data

Jun. 1975 51 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-A N76-17469; Vol. 1-B N76-17501; Vol. 1-C N76-17552; Vol. 1-D N76-17588 Original contains imagery. Original NASA photography may be purchased from the EROS DATA Center, 10th and Dakota Avenue, Sious Falls, S.D. 5179

(NASA-TM-X-58168-Vol-3; JSC-09930-Vol-3) Avail: NTIS HC $1.00 CSCL 05B

This document contains the proceedings and summaries of the earth resources survey symposium, sponsored by the NASA Headquarters Office of Applications and held in Houston, Texas, June 9 to 12, 1975. Topics include the use of remote sensing techniques in agriculture, in geology, for environmental monitoring, for land use planning, and for management of water resources and coastal zones. Details are provided about services available to various users. Significant applications, conclusions, and future needs are also discussed. For individual titles, see N76-17614 through N76-17621.

N76-17614* Cargill, Inc., Minneapolis, Minn.

AGRICULTURE

Richard Baldwin *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 1-3 (For availability see N76-17613 08-43)

CSCL 02C

Applications of remote sensing in the areas of crop identification, range management, forest management and soil mapping are summarized. D.M.L.

N76-17615* National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.

COASTAL ZONE MANAGEMENT

E. Lee Tilton, III *In its* NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 5-14 refs (For availability see N76-17613 08-43)

CSCL 08C

A panel of federal and state representatives concerned with coastal zone affairs discussed their problems in this area. In addition, several demonstrations of the application of remote sensing technology to coastal zone management were described. These demonstrations were performed by several agencies in a variety of geographical areas. Author

N76-17616* Oregon Dept. of Environmental Quality, Portland.

ENVIRONMENT

Ronald L. Myles *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 15-19 (For availability see N76-17613 08-43)

CSCL 08F

Applications of remote sensing technology to wildlife preservation, pest control, strip mining, water quality monitoring, and wetlands mapping were discussed. Economic, political and social factors were also considered. D.M.L.

N76-17617* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

GEOLOGY

Robert K. Stewart, Floyd F. Sabins, Jr. (Chevron Oil Field Res. Co.), Lawrence C. Rowan (Geological Survey, Reston, Va.), and Nicholas M. Short (NASA. Goddard Space Flight Center, Greenbelt, Md.) *In its* NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 21-28 (For availability see N76-17613 08-43)

CSCL 08G

Papers from private industry reporting applications of remote sensing to oil and gas exploration were presented. Digitally processed LANDSAT images were successfully employed in several geologic interpretations. A growing interest in digital image processing among the geologic user community was shown. The papers covered a wide geographic range and a wide technical and application range. Topics included: (1) oil and gas exploration, by use of radar and multisensor studies as well as by use of LANDSAT imagery or LANDSAT digital data, (2) mineral exploration, by mapping from LANDSAT and Skylab imagery and by LANDSAT digital processing, (3) geothermal energy studies with Skylab imagery, (4) environmental and engineering geology, by use of radar or LANDSAT and Skylab imagery, (5) regional mapping and interpretation, and digital and spectral methods. Author

N76-17618* Purdue Univ., Lafayette, Ind.

INFORMATION SYSTEMS AND SERVICES, USER SERVICES

David A. Landgrebe *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 29-33 (For availability see N76-17613 08-43)

CSCL 05B

The following topics were discussed: (1) data availability and distribution, (2) complete processing systems, (3) subsystems,

(4) applications, (5) research for future technology, and (6) education, training opportunities, and materials. Evidence was given that remote sensing technology is being increasingly utilized. Therefore, it was concluded that a second stage of remote sensing technology should be developed. D.M.L.

N76-17619* Georgia Dept. of Natural Resources, Atlanta.
LAND USE, STATE AND LOCAL USERS
Charles M. Parrish, III *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 35-38 (For availability see N76-17613 08-43)
CSCL 08B

The state and local and land use sessions involved a cross section of the expanding community of government managers who use remotely sensed information to make programmatic decisions. Problems that can be inferred from the presentations and resulting discussion are addressed. Recommendations are also given to facilitate utilization of remote sensing technology. Author

N76-17620* National Environmental Satellite Service, Washington, D.C.
MARINE RESOURCES
John W. Sherman, III *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 39-40 (For availability see N76-17613 08-43)
CSCL 08A

The papers presented in the marine session may be broadly grouped into several classes: microwave region instruments compared to infrared and visible region sensors, satellite techniques compared to aircraft techniques, open ocean applications compared to coastal region applications, and basic research and understanding of ocean phenomena compared to research techniques that offer immediate applications. Author

N76-17621* Colorado State Univ., Fort Collins.
WATER RESOURCES
D. B. Simons *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 41-46 (For availability see N76-17613 08-43)
CSCL 08H

Applications of remote sensing technology to analysis of watersheds, snow cover, snowmelt, water runoff, soil moisture, land use, playa lakes, flooding, and water quality are summarized. Recommendations are given for further utilization of this technology. D.M.L.

N76-17622# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF ESTIMATING THE INFORMABILITY OF PHOTOGRAPHS RECEIVED FROM SATELLITES
N. B. Trapeznikova [1975] 6 p refs Transl. into ENGLISH from Tr. Gidrometeorolog. Nauchno.-Issled. Tsentr. SSSR, Sputnikovaia Meteorol. (USSR), no. 148, 1974 p 66-72
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Procedures for selecting the most appropriate scan photograph for the best information possible are discussed. Data cover comparisons of images of different scales in the same spectrum and in different spectrum bands, recognizing characteristics of the object being studied, satellite scanning altitude and scanning angle of optical system used, and resolution of the apparatus in which the minimum size of the objects seen in the photograph depends. It was also concluded that type of photographic film and film processing procedures, quality of reproducible brightness gradients, and performance of ground receivers affect image quality. E.H.W.

N76-17623# World Meteorological Organization, Geneva (Switzerland).
GUIDE TO HYDROLOGICAL PRACTICES
1974 402 p refs
(WMO-168) Avail: NTIS HC $11.00; WMO, Geneva Sw. Fr. 55

The aim of the guide is to provide information about hydrological practices, procedures and instrumentation. Following a general chapter, sections cover instruments and methods of observation; design of networks; collection, processing and publication of data; hydrological analysis; and hydrological forecasting. Applications of hydrological methods to water management is covered by an appendix. Extensive bibliographies follow each section. For individual titles, see N76-17624 through N76-17629.

N76-17624 World Meteorological Organization, Geneva (Switzerland).
INSTRUMENTS AND METHODS OF OBSERVATION c35
In its Guide to Hydrol. Pract. 1974 97 p refs (For availability see N76-17623 08-43)

Instruments and methods of observation used in hydrological services are reviewed for the following areas: precipitation; snow cover; evaporation and evapotranspiration; water level; discharge measurements; sediment discharge; water temperature; ice; soil moisture and ground water. A bibliography is appended. ESA

N76-17625 World Meteorological Organization, Geneva (Switzerland).
DESIGN OF NETWORKS
In its Guide to Hydrol. Pract. 1974 22 p refs (For availability see N76-17623 08-43)

The general requirements of and general principles for the design of hydrological and climatological networks are reviewed. The development of a minimum network is discussed together with the data to be considered in determining the network density. Such data include precipitation and snow cover, water temperature, evaporation snd soil moisture. The factors affecting the density of observation stations for a minimum network are noted and the minimum density limit of climatological and hydrometric networks is discussed. The integration of bench-mark stations and representative basins in the network are also considered. ESA

N76-17626 World Meteorological Organization, Geneva (Switzerland).
COLLECTION, PROCESSING AND PUBLICATION OF DATA
In its Guide to Hydrol. Pract. 1974 35 p refs (For availability see N76-17623 08-43)
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The observational procedures, transmission of hydrological observations, quality control and storage and cataloging of data collected for hydrological purposes are considered. As an example the computation and quality control of streamflow data is described. General methods of data processing are discussed together with the requirements for special applications such as runoff, soil moisture, snow and ice cover. The need for publication of the data is discussed with attention paid to frequency and formats as well as hydrological requirements. ESA

N76-17627 World Meteorological Organization, Geneva (Switzerland).
HYDROLOGICAL ANALYSIS
In its Guide to Hydrol. Pract. 1974 110 p refs (For availability see N76-17623 08-43)

Methods of analysis covering the procedures required for most hydrological purposes are presented. The interpretation of precipitation data, with emphasis on storm rainfall studies, rainfall frequency and intensity and snowmelt, and streamflow data, noting temporal distribution of runoff volume, streamflow routing and flood frequencies, for the purposes of analysis are discussed. The determination of evaporation by various methods is described together with estimates of basin evapotranspiration. The runoff relation between rainfall and snowfall are also considered. A bibliography is appended. ESA

N76-17628 World Meteorological Organization, Geneva (Switzerland).
HYDROLOGICAL FORECASTING
In its Guide to Hydrol. Pract. 1974 63 p refs (For availability see N76-17623 08-43)

The importance of hydrological forecasting is stressed and an idea of the types of hydrological forecasts such as flood predictions, water runoff and snow melt are given. The principal basic methods used to forecast the most important elements of the hydrological regime are described and the applicability of these methods under different climatic conditions is discussed.

The forms of hydrological forecasts and their verification are also summarized. ESA

N76-17629 World Meteorological Organization, Geneva (Switzerland).
APPLICATIONS TO WATER MANAGEMENT
In its Guide to Hydrol. Pract. 1974 41 p refs (For availability see N76-17623 08-43)

The application of hydrological analysis methods to the design of water management projects is discussed. An estimation of available surface water supplies is made followed by estimation of design floods. The methods of estimating are described and summarized. The design of flood control works and urban and small catchment drainage works are discussed. An estimation of maximum reservoir levels is also given. ESA

N76-17630# Institut Geographique National, Paris (France). Groupement Recherche, Etudes et Developpement.
APPLICATION OF PHOTOGRAMMETRIC CAMERAS AND SENSORS FOR EARTH SURVEY MISSION USING SPACELAB [ETUDE SUR L'EMPLOI DE CHAMBRES PHOTOGRAMMETRIQUES ET DE CAPTEURS POUR DES MISSIONS DE LEVES TERRESTRES UTILISANT SPACELAB]
Sep. 1975 193 p refs In FRENCH
(Contract ESRO-SC/68-HQ)
(ESA-CR(P)-718) Avail: NTIS HC $7.50

A study on photogrammetric systems and sensors for earth survey onboard spacelab is presented. The characteristics of photogrammetric, orthophotographic, and MSS cameras, are reviewed. Detailed analyses were carried out on camera choice types of photographic films, film stockpile, rotating mirrors, and optical quality windows. For individual titles, see N76-17631 through N76-17636.

N76-17631 Institut Geographique National, Paris (France).
FINAL SUMMARY REPORT [RAPPORT SOMMAIRE FINAL]
Guy Ducher *In its* Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab 24 Jun. 1975 44 p refs In FRENCH (For availability see N76-17630 08-43)
(GRED/GD/149)

The definition of a system of metric chambers and multispectral band cameras for earth photogrammetry onboard Spacelab is reviewed. User needs are detailed with regard to detectability and image acutance for cartographic uses with 10 meters detectability and 20 meters resolution. The altimetric conditions for Spacelab are derived. The favorable spectral bands required are discussed leading to an overall proposal for orthophotography equipment and multispectral band cameras. The optical window requirements are detailed to suit the cameras. Film supplies and film quality are considered. A general schedule for manufacture, testing, and reception of the systems is outlined. ESA

N76-17632 Institut Geographique National, Paris (France).
CHOICE OF CAMERAS AND ITS IMPLEMENTATION [RAPPORT TECHNIQUE SUR LE CHOIX DU MATERIEL DE PRISE DE VUES ET SA MISE EN OEUVRE]
J. Ducloux *In its* Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab May 1975 27 p In FRENCH (For availability see N76-17630 08-43)

The performance of various types of camera for earth photogrammetry and orthophotography onboard Spacelab are reviewed. An estimate of image quality and ground detectability is given together with an assessment of possible cartographic uses. Image motion compensation aspects are detailed using the transfer function theory. Implementation of the equipment on the Spacelab pallet or inside the cabin is reviewed with regard to temperature and pressure effects, hard radiation effects, optical window dimensions, and mechanical fixation. Elements for camera choice are given with regard to performance, ease of use, costs, and image exploitation. A timetable for manufacture, test, and acceptance, is proposed. ESA

N76-17633 Institut Geographique National, Paris (France).
DEFINITION OF THE SPACELAB MULTISPECTRAL BAND CAMERAS [RAPPORT SUR LA DEFINITION DES CHAMBRES DE PRISE DE VUES MULTI-SPECTRALES DU SATELLITE SPACELAB]
Alain Baudoin *In its* Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab 22 May 1975 14 p In FRENCH (For availability see N76-17630 08-43)
(GRED/AB/119)

User requirements for MSS onboard Spacelab are reviewed with regard to spatial resolution from which conditions on Spacelab altitude, focal length, film resolution, and image motion compensation are derived. The useful spectral bands are discussed together with superposing images, field of view problems, and radiometric precision. Criteria for choice of the MSS equipment are given with regard to lenses, film type, and focal length. ESA

N76-17634 Institut Geographique National, Paris (France).
FILMS FOR PHOTOGRAMMETRIC CAMERA [FILMS POUR CHAMBRE METRIQUE]
Michel Osche and Guy Ducher *In its* Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab 14 May 1975 9 p In FRENCH (For availability see N76-17630 08-43)
(GRED/GD/116)

Available film thicknesses are reviewed and discussed in view of use with the Spacelab photogrammetric camera. The amount of film required for complete stereoscopic coverage of western Europe is discussed with regard to magazine capability (250 views) and camera focal length. The constraint of flight duration is detailed leading to an optimal strategy, taking into account orbital drift. Film stock onboard is dealt with considering temperature, humidity and radiation protection. ESA

N76-17635 Institut Geographique National, Paris (France).
GROUND COVERAGE OF AN INCLINED MIRROR CAMERA [LARGEUR AU SOL COUVERTE PAR UNE CHAMBRE A MIROIR INCLINABLE]
Guy Ducher *In its* Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab 14 May 1975 12 p In FRENCH (For availability see N76-17630 08-43)
(GRED/GD/117)

The advantages of a rotating mirror to compensate for image movement and enhance the field of view of the photogrammetric camera onboard Spacelab are reviewed. The resulting scale effect and ground strip covered width are calculated. Discussion of results led to choice of rotation angle at 15 degrees either way. ESA

N76-17636 Engins Matra, Velizy (France).
FEASIBILITY OF A LARGE OPTICAL WINDOW FOR SPACELAB [ETUDE DE FAISABILITE D'UNE FENETRE OPTIQUE DE GRANDES DIMENSIONS POUR LA NAVETTE SPACELAB]
Jean-Pierre Elissalde *In* Inst. Geograph. Natl. Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission during Spacelab 16 Apr. 1975 53 p In FRENCH (For availability see N76-17630 08-43)

The parameters to be satisfied by the Spacelab optical window are reviewed with regard to optical factors and environmental factors such as radiation effects, vibration levels, thermal stresses, and shock resistance. Borosilicate glass versus pure silica glass is discussed. A detailed examination of parallelism tolerance, planeity, flexure, and temperature gradient effects, is performed. Antireflection coatings and heating coatings are evaluated. Radiation effects are discussed together with mechanical resistance aspects, such as window thickness, deformation, vibrations, mechanical reliability, humidity effects, fracture mechanics, and chemical annealing. Mechanical fixation and thermal stresses are detailed together with safety measures to be implemented. ESA

N76-17637# Environmental Research Inst. of Michigan, Ann Arbor.
THE APPLICATION OF REMOTE SENSING TECHNOLOGY TO LOCAL ENVIRONMENTAL PLANNING AND PUBLIC POLICY FORMULATION Final Summary Report, Jun. 1972 - Nov. 1974
R. Keith Raney Jun. 1975 62 p refs
(Grant NSF GI-34809)
(PB-245619/2; ERIM-193500-6-F; NSF/RA/E-75/035) Avail: NTIS HC $4.50 CSCL 13B

Use of the technology of remote sensing information systems included: (1) Determination of the present sources, content, and flow of information within and between selected agencies, (2) introduction of remotely sensed information into these agencies, and (3) assessment of the actual and likely future impact of such information on public decisions effected by the agencies. GRA

N76-17638# Environmental Research Inst. of Michigan, Ann Arbor.
THE PROSPECTS FOR IMPROVING HIGHWAY PLANNING THROUGH REMOTE SENSING INFORMATION SYSTEMS: A CASE STUDY FOR MICHIGAN Final Report, Jun. 1972 - Nov. 1974
A. N. Sellman and K. P. Warner Jul. 1975 90 p refs
(Grant NSF GI-34809)
(PB-245621/8; ERIM-193500-6-F2) Avail: NTIS HC $5.00 CSCL 13B

This volume is the final report of a three year study funded by the National Science Foundation to identify and measure the impact of remote sensing on highway planning objectives. During that time the Environmental Research Institute of Michigan (ERIM) maintained a cooperative research program with the Michigan Department of State Highways and Transportation (MDSH&T) to focus on three major issues facing highway planners today: (1) the traditional problem of coordinating many divisions to achieve an integrated planning goal, (2) the institutional and programmatic reorganization engendered by the Action Plan guidelines of the Federal Highway Administration, and (3) the capacity of contemporary remote-sensing technologies to supply environmental information required for highway planning as practiced today. GRA

N76-17639# Environmental Research Inst. of Michigan, Ann Arbor.
INLAND LAKES WATER QUALITY AND WATERSHED PLANNING: REMOTE SENSING TECHNOLOGY APPLICATIONS Final Report, May 1971 - Jun. 1974
T. Borton, C. T. Wezernak, and R. K. Raney Jun. 1975 189 p refs
(Grant NSF GI-34809)
(PB-245620/0; ERIM-193500-6-F1; NSF/RA/E-75/036) Avail: NTIS HC $7.50 CSCL 13B

This is the final report of a task force exploring the impact of remote sensing and other information systems on public planning and policy decisions related to land development within the drainage basin of a small inland lake. The issue is one of maintaining water quality in the face of pressure to increase the cultural use of the watershed. The approach of the task force was three-fold: (1) to gather, interpret, and provide information regarding the issue to local decision makers; (2) to assist in motivating a common problem recognition among the local people; and (3) to withdraw from the local area, leaving behind sufficient technical resources to meet the needs of local initiatives to action, and to observe early phases of changed environmental decision making. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N76-17640*# Florida Univ., Gainesville.
NUCLEAR WASTE DISPOSAL UTILIZING A GASEOUS CORE REACTOR
Richard R. Paternoster [1975] 42 p refs
(Grant NGL-10-005-089)
(NASA-CR-146418) Avail: NTIS HC $4.00 CSCL 10B

The feasibility of a gaseous core nuclear reactor designed to produce power to also reduce the national inventories of long-lived reactor waste products through nuclear transmutation was examined. Neutron-induced transmutation of radioactive wastes is shown to be an effective means of shortening the apparent half life. Author

N76-17641*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTROLYTIC HYDROGEN PRODUCTION: AN ANALYSIS AND REVIEW
John Evangelista, B. Phillips, and L. Gordon Dec. 1975 70 p refs
(NASA-TM-X-71856; E-8602) Avail: NTIS HC $4.50 CSCL 10A

The thermodynamics of water electrolysis cells is presented, followed by a review of current and future technology of commercial cells. The irreversibilities involved are analyzed and the resulting equations assembled into a computer simulation model of electrolysis cell efficiency. The model is tested by comparing predictions based on the model to actual commercial cell performance, and a parametric investigation of operating conditions is performed. Finally, the simulation model is applied to a study of electrolysis cell dynamics through consideration of an ideal pulsed electrolyzer. Author

N76-17642*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY: A SELECTIVELY COATED, FLAT-PLATE COPPER COLLECTOR WITH ONE TRANSPARENT COVER AND A TUBE-TO-TUBE SPACING OF 5 5/8 INCHES
Feb. 1976 7 p ref
(NASA-TM-X-71871; E-8644) Avail: NTIS HC $3.50 CSCL 10A

This preliminary data report gives basic test results of a flat-plate solar collector whose performance was determined in the NASA-Lewis solar simulator. The collector was tested over ranges of inlet temperatures, fluxes and coolant flow rates. Collector efficiency is correlated in terms of inlet temperature and flux level. Author

N76-17643*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STANDARDIZED PERFORMANCE TESTS OF COLLECTORS OF SOLAR THERMAL ENERGY: A SELECTIVELY COATED, STEEL COLLECTOR WITH ONE TRANSPARENT COVER
Jan. 1976 7 p ref
(NASA-TM-X-71870; E-8641) Avail: NTIS HC $3.50 CSCL 10A

Basic test results are presented of a flat-plate solar collector whose performance was determined in solar simulator. The collector was tested over ranges of inlet temperatures, fluxes and coolant flow rates. Collector efficiency was correlated in terms of inlet temperature and flux level. Author

N76-17644# Committee on Science and Technology (U. S. House).
HYDROGEN
Washington GPO 1975 1369 p refs Hearings before Subcomm. on Energy Res., Develop. and Demonstration of Comm. on Sci. and Technol., 94th Congr., 1st Sess., No. 29, 10 and 12 Jun. 1975
(GPO-62-332) Avail: Subcomm. on Energy Res., Develop. and Demonstration

The production and utilization of hydrogen as a source of energy are considered in terms of their effects on the energy economy of the future. Factors discussed include: environmental hazards; cleanliness of hydrogen combustion; compatibility with existing industrial infrastructure; and safety and cost considerations. J.M.S.

N76-17645*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FUNCTIONING OF INORGANIC/ORGANIC BATTERY SEPARATORS IN SILVER-ZINC CELLS
Warren H. Philipp and Charles E. May Washington Feb. 1976

21 p refs
(NASA-TM-X-3357; E-8216) Avail: NTIS HC $3.50 CSCL 10C

The results of three experimental studies related to the inorganic/organic battery separator operating mechanism are described: saponification of the plasticizer, resistivity of the simulated separators, and zincate diffusion through the separators. The inorganic/organic separator appears to be a particular example of a general class of ionic conducting films composed of inorganic fillers and/or substrates bonded together by an organic polymer containing an incompatible plasticizer that may be leached by the electrolyte. The I/O separator functions as a microporous film of varying tortuosity with essentially no specific chemical inhibition to zincate diffusion. Author

N76-17646# EIC, Inc., Newton, Mass.
SULFUR-BASED LITHIUM-ORGANIC ELECTROLYTE SECONDARY BATTERIES Quarterly Report, 4 Dec. 1974 - 3 Mar. 1975
Gerhard L. Holleck and Joseph R. Driscoll Aug. 1975 36 p refs
(Contract DAAB07-74-C-0072; DA Proj. 1T1-61102-A-34A)
(AD-A014881; C-405-5; ECOM-74-0072-5; QR-5) Avail: NTIS CSCL 10/3

This program was aimed at developing a rechargeable organic-electrolyte lithium battery to operate over the range -40 to +160 F, have an energy density approaching 100 Whr/lb, a cycle life in excess of 500, and high charge retention. The approach was to use positive electrodes based on higher sulfides of Nb, Ti and V. Titanium disfulides and trisulfides were prepared thermally. They were characterized by scanning electron microscopy and by X-ray diffraction. Both sulfides are electrochemically active and show similar overall behavior. Charge-discharge cycles in PC Li, Al, C14, Li, Cl, O4, Li, Be4 electrolytes are characterized by relatively flat voltage plateaus with mid-discharge potentials of 2.0 V. GRA

N76-17647# Eagle-Picher Industries, Inc., Joplin, Mo.
NEW MECHANICALLY RECHARGEABLE ZINC-AIR BATTERIES Final Report, 15 Apr. 1973 - 30 Apr. 1975
John Giltner Aug. 1975 50 p refs
(Contract DAAB07-73-C-0149; DA Proj. 1G7-63702-DG-10)
(AD-A015018) Avail: NTIS CSCL 10/3

This report describes the design, development and testing of new mechanically rechargeable zinc-air batteries. Following research and development of a low cost silver-mercury cathode catalyst, prototype battery tests were conducted. Cycle life tests at 3.5 amperes indicated satisfactory performance through at least 26 cycles when this test was terminated for the final hardware build. The cathode bi-cell design utilized the 75 AH plastic frames which were cut down in height and width. Woven-zinc anodes were tested during the program, but were found to operate at reduced voltage and efficiency. The final anode design was a dry pressed composition of zinc, KOH, and HgO and indicated a very good efficiency at 3.5 amperes. Final batteries were delivered in fabricated plexiglass cases with 22 series - connected cells. Discharge tests were conducted on nine (9) of the ten (10) delivered batteries. GRA

N76-17648# Dayton Univ. Research Inst., Ohio. Research Inst.
COMPUTER STUDIES OF ELECTROFLUID DYNAMIC GENERATORS Final Report, 3 Oct. 1971 - 2 Oct. 1974
John E. Minardi and Paul T. Bauer ARL Jun. 1975 100 p refs
(Contract F33615-72-C-1220; AF Proj. 7116)
(AD-A014726; ARL-75-0138) Avail: NTIS CSCL 10/2

Computer studies of the electric fields and fluid fields in an electrofluid dynamic generator of complex electrode designs are presented. Results of studies are presented for both basic configurations and configurations which simulate real experimental designs. A comparison of experimentally determined I-V curves is made with an I-V curve determined from the computer results. The computed results predicted higher values of current than were achieved in the experimental configuration. The computer studies indicated that the current cut off by breakdown on the inlet nozzle was quite sensitive and that this may account for the difference between the experimental and calculated I-V curves. The results obtained from the basic studies indicate design considerations that could improve the power output of electrofluid dynamic generators. Some results are also presented for the fluid fields in the generator, and a discussion of various fluid flow models is presented. The results presented for turbulent mixing studies indicate the need for a large secondary stream and a value approaching unity for the ratio of the secondary velocity to that of the primary. GRA

N76-17649# Air Force Weapons Lab., Kirtland AFB, N.Mex.
ALTERNATIVE ENERGY SOURCES FOR UNITED STATES AIR FORCE INSTALLATIONS Final Report, Jul. 1974 - Jun. 1975
Michael D. DeWitte Aug. 1975 111 p refs
(AF Proj. 2102)
(AD-A014858; AFWL-TR-75-193) Avail: NTIS CSCL 10/1

This report is concerned with the consumption and cost of facilities-related energy, both present and future, at Air Force installations, and it presents a basic assessment of the potential of alternative energy sources. In particular-solar, wind, and geothermal energy resources are investigated. GRA

N76-17650# Army Construction Engineering Research Lab., Champaign, Ill.
TECHNICAL EVALUATION STUDY: ENERGY-RECOVERY SOLID WASTE INCINERATION TO NAVAL STATION, MAYPORT, FLORIDA
S. A. Hathaway and H. G. Rigo Feb. 1975 60 p refs
(AD-A015615; CERL-TR-E-51) Avail: NTIS CSCL 21/4

This study was undertaken to assess the feasibility of energy-recovery incineration of solid waste at Naval Station Mayport, Florida. It was found that use of solid waste as a fuel for steam generation at Naval Station Mayport is technically and economically feasible and environmentally compatible. The recommended system employs a clean-fuel fired, basket-grate incinerator in series with an energy-recovery train consisting of an afterburner and boiler. The afterburner fires fuel reclaimed at an on-station bilge and fuel tank waste oil treatment facility. Refuse-derived fuel (RDF) is fired one shift, five days per week, with the auxiliary burner assuming the load during nights and weekends. Production of 22,700 pounds of steam/hour can be achieved. The benefit-to-cost ratio of this system is 8:1. Through implementation of this system a net fuel savings of 345,800 gallons/yr can be achieved, excluding the amount of the reclaimed oil used. Design criteria are provided. GRA

N76-17651# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
AN ANNULAR FLOW ICE-WATER MODEL HEAT SINK
James L. Brown and William F. Quinn Sep. 1975 74 p refs
(AD-A015468; CRREL-SR-236) Avail: NTIS CSCL 13/1

An analytical and laboratory experimental study was conducted on a scale model annular flow ice-water heat sink which represent a medium for storing waste heat developed by a hardened defense installation during a transient period in which it operates on a closed cycle system. The study developed (1) an understanding of the flow processes and melting patterns in such a sink, (2) a mathematical procedure for predicting relationships between coolant water and heat rejection rates, (3) a validation of the math procedure using a scaled experiment model, and (4) an assessment of the effect of some water inlet manifold configurations. Advantageous performance characteristics include provision for (1) maximum thermal efficiency during the early (probably most crucial) stages of use and (2) a relatively constant outlet sink temperature to the power plant heat exchanger during the ice melting period. GRA

N76-17652# Army Construction Engineering Research Lab., Champaign, Ill.
TECHNICAL EVALUATION STUDY: SOLID WASTE HEAT RECLAMATION AT NAVAL AIR TEST CENTER PATUXENT, MARYLAND
H. G. Rigo and G. E. Quindry Nov. 1974 46 p refs
(AD-A015613; CERL-TR-E-60) Avail: NTIS CSCL 13/2

This study was initiated to evaluate the solid waste disposal system at Naval Air Test Center, Patuxent, MD, and to ascertain the feasibility of solid waste heat reclamation at the base. The solid waste stream was analyzed, applicable standards were

evaluated, and the cost and performance characteristics of current solid waste heat reclamation units were reviewed. Recommendations were based on consideration of the facility benefit to cost ratio. It was found that continuing the current method of solid waste disposal, an on-base landfill operation, would be economically and environmentally sound. New solid waste collection equipment and altered procedures at the landfill site were recommended to substantially improve the economics and life expectancy of the on-base refuse management system. GRA

N76-17653# Gould, Inc., St. Paul, Minn. Energy Research Lab.
R AND D FOR HYBRID BATTERY AND CELL STUDIES Final Report, 1 Apr. 1973 - 15 Apr. 1975
Clinton C. Christianson, Claude J. Menard, Richard J. Rubiskchko, and David M. Thimmesch Aug. 1975 104 p refs
(Contract DAAB07-73-C-0127; DA Proj. 1S7-62705-AH-94)
(AD-A015520; ECOM-73-0127-F) Avail: NTIS CSCL 10/3

Three areas of work are described. These are the Primary Battery Investigation, the Secondary Battery Investigation, and the System Design and Charge Control Development. The primary battery investigation covered zinc-air, Li-organic, Zn-HgO, and Mg-MnO2 cells with cell performance being characterized over a temperature range of -40 to 140F and a load current range of C/250 to C/5. Highest energy density was obtained from the zinc-air and Li-organic cells with the zinc-air cells showing superior energy density at temperatures above 0F and the Li-organic cells giving better performance at temperatures below 0F. Energy density, voltage and capacity data are presented for the primary systems over the temperature ,and load range previously indicated. A high-rate low temperature sealed nickel-cadmium cell, of a sub-C size, was developed and is described. Secondary performance data indicates that hybrid operation, at discharge and charge rates of 6C and 1C, respectively and cell temperatures as low as 10F, will be possible without parasitic heaters. Reliable operation below 10F will require the use of parasitic heaters. Various methods of charge state sensing and charge control were investigated and are described. GRA

N76-17654# Schlesinger (Robert J.), Tarzana, Calif.
HYBRID SIMULATION OF SOLAR HVAC SYSTEM FOR HOUSE RETRO-FIT DESIGN Semiannual Progress Report, 1 Jul. - 31 Dec. 1974
Robert J. Schlesinger 31 Jan. 1975 47 p
(Grant NSF GI-43896)
(PB-245425/4; NSF/RA/N-75-070) Avail: NTIS HC $4.00 CSCL 13A

The development of a small analog solar HVAC simulator that can be used as a research tool as well as provide a possible approach to sizing solar systems for retro-fit installations in dwellings was treated. The system concept and implementation of this concept in terms of the hardware and software developed are discussed. GRA

N76-17655# Pennsylvania State Univ., University Park.
ENERGY CONSERVATION THROUGH URBAN TRANSPORTATION PLANNING Final Report
Mar. 1975 186 p refs
(PB-245214/2; PTI-7515) Avail: NTIS HC $7.50 CSCL 10A

Techniques for conserving energy in urban passenger transport are described. A systems approach for evaluating these simultaneously in order to formulate areawide passenger transportation energy policy is presented. It consists of a simple computer technique for estimating the conservation value of various schemes. The program is also of value in assessing the energy impact of individual energy conserving programs. Because only local planners are familiar with the economic, environmental, and political constraint on policy and programs, the tool is intended for use in urban regions. It is, however, written in general terms and as such, if used in all urban areas in the U.S., could offer realistic national estimates of urban passenger transportation energy requirements in the short term. GRA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N76-17656* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STACK PLUME VISUALIZATION SYSTEM Patent
Reginald J. Exton, inventor (to NASA) Issued 6 Jan. 1976 6 p Filed 11 Mar. 1975 Supersedes N75-20091 (13 - 11, p 1308)
(NASA-Case-LAR-11675-1; US-Patent-3,931,462; US-Patent-Appl-SN-557448; US-Patent-Class-178-6.8; US-Patent-Class-178-DIG.1; US-Patent-Class-178-DIG.8; US-Patent-Class-250-373; US-Patent-Class-340-237S; US-Patent-Class-356-207) Avail: US Patent Office CSCL 13B

A method and apparatus for measuring, at a remote location, the concentration and velocity of SO2 in plume from a smokestack are described. An ultraviolet video system views the plume against the background sky at wavelengths where SO2 molecules absorb light. The result is a real time display of the plume coupled with means for measuring the SO2 concentration at any point in the plume and at any time desired. In addition, means are provided in combination with the ultraviolet video system for measuring the velocity of the SO2 in the plume.
Official Gazette of the U.S. Patent Office

N76-17657*# Old Dominion Univ., Norfolk, Va.
ATMOSPHERIC AEROSOLS: A LITERATURE SUMMARY OF THEIR PHYSICAL CHARACTERISTICS AND CHEMICAL COMPOSITION
Franklin S. Harris, Jr. Washington NASA Jan. 1976 44 p refs
(Grant NGR-47-003-068)
(NASA-CR-2626) Avail: NTIS HC $4.00 CSCL 13B

This report contains a summary of 199 recent references on the characterization of atmospheric aerosols with respect to their composition, sources, size distribution, and time changes, and with particular reference to the chemical elements measured by modern techniques, especially activation analysis. Author

N76-17658*# Cramer (H.E.) Co., Inc., Salt Lake City, Utah.
NASA/MSFC MULTILAYER DIFFUSION MODELS AND COMPUTER PROGRAMS, VERSION 5
R. K. Dumbauld and J. R. Bjorklund Dec. 1975 322 p refs
(Contract NAS8-29033)
(NASA-CR-2631; M155) Avail: NTIS HC $9.75 CSCL 13B

The transport and diffusion models and algorithms developed for use by NASA in predicting concentrations and dosages downwind from normal and abnormal launches of rocket vehicles are described along with the associated computer programs for use in performing the calculations. Topics discussed include: the mathematical specifications and procedures used in the Preprocessor Program to calculate rocket exhaust cloud rise, cloud dimensions, and other input parameters to the transport and diffusion models; the revised mathematical specifications for the Multilayer Diffusion Models; users' instructions for implementing the Preprocessor and Multilayer Diffusion Models Programs; and worked example problems illustrating the use of the models and computer programs. Author

N76-17659# Oak Ridge National Lab., Tenn.
DEFINING AND DETERMINING THE SIGNIFICANCE OF IMPACTS: CONCEPTS AND METHODS
S. W. Christensen, W. VanWinkle, and J. S. Mattice 1975 71 p refs Presented at Workshop on the Biol. Significance of Environ. Impacts, Ann Arbor, Michigan, 4 Jun. 1975 Sponsored by ERDA
(Conf-750646-1) Avail: NTIS HC $6.75

The term impact is conceptually and mathematically defined to be the difference in the state or value of an ecosystem with versus without the source of impact. Some resulting problems associated with the measurement of impacts based on comparisons of baseline and operational data are discussed briefly. The concept of a significant adverse impact on a biological system is operationally defined in terms of an adverse impact which,

according to a proposed decision tree, justifies rejection of a project or a change in its site, design, or mode of operation. A gradient of increasing difficulty in the prediction of impacts exists as the scope of the assessment is expanded to consider long term, far-field impacts with respect to higher levels of biological organization (e.g., communities or ecosystems). The analytical methods available for predicting short term, near-field impacts are discussed. Finally, the role of simulation modeling as an aid to professional judgment in predicting the long term, far-field consequences of impacts is considered, and illustrated with an example. Author (NSA)

N76-17660# Radian Corp., Austin, Tex.
IDENTIFICATION OF REGENERABLE METAL OXIDE SO2 SORBENTS FOR FLUIDIZED-BED COAL COMBUSTION Final Report, Jun. 1974 - Apr. 1975
P. S. Lowell and T. B. Parsons Jul. 1975 205 p refs
(Contract EPA-68-02-1319)
(PB-244402/4; EPA-650/2-75-065) Avail: NTIS HC $7.75 CSCL 07D

Results are summarized of an analysis to identify regenerable metal oxide SO2 sorbents for fluidized-bed coal combustion. It discusses both the approach used for the theoretical study of sorption/regeneration processes and implications of the results are discussed. The Appendix contains two technical notes that are major products of this effort: 'Thermodynamic Screening of Dry Metal Oxides for High Temperatures SO2 Removal', giving complete details of the thermodynamic analysis of the sorption process; and 'The Thermodynamics of Chemical Regeneration of Metal Oxide SO2 Sorbents,' giving detailed methods and results of the identification of sorbents that can be regenerated by reductive decomposition of the sulfate. GRA

N76-17661# Southern Research Inst., Birmingham, Ala.
INVESTIGATION OF LUMINOL AND COLLECTION TAPE COMPONENTS AND THE EFFECTS OF AIRBORNE INTERFERENTS ON THE XM19 DETECTOR Quarterly Progress Report
William J. Barrett and Herbert C. Miller 31 Jan. 1975 13 p ref
(Contract DAAA15-74-C-0206)
(AD-A007274; SORI-EAS-75-049; QPR-2) Avail: NTIS CSCL 15/2

The effects of airborne interferents, the development of collection tape components, and the luminol chemical system for the XM19 biological aerosol detector are examined. The detection principle is based on the iron porphyrin-catalyzed oxidation of luminol in alkaline solution by hydrogen peroxide, the result of which is the chemiluminescent emission of light. Sampling of biological materials in air is accomplished with a collector-concentrator, which isolates and concentrates particles in the respirable size range, and a continuously moving collection tape, which collects these particles by impaction. The biological particles are removed from the tape by washing it continuously with water. The wash water is mixed with the chemical reagents and the intensity of the emitted light is measured with a photomultiplier tube. The photomultiplier views the reaction mixture at two different intervals of time after the reagents are mixed with the sample. Measurement of the ratio of the two signals permit discrimination against some interferents, depending on differences in reaction rates. The storage of solid oxidants, the use of a luminol-perborate premix, and the problems caused by dust interferences are also studied. Author

N76-17662# Naval Weapons Center, China Lake, Calif.
ENVIRONMENTAL IMPACT MODEL DEVELOPMENT FOR NAVAL OPERATIONS Final Report
James R. Ouimette Aug. 1975 31 p refs
(AD-A015288; NWC-TP-5793) Avail: NTIS CSCL 13/2

This report examines various air and water pollution simulation models and environmental impact methodologies to determine suitability for Navy needs. Certain models are recommended for Navy use to maintain a cost-effective information response system. GRA

N76-17663# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
THE APPLICATION OF PATTERN RECOGNITION TECHNIQUES TO THE CHARACTERIZATION OF ATMOSPHERIC AEROSOLS Interim Technical Report
S. P. Perone, M. Pichler, P. Gaarenstroom, and J. L. Moyers (Arizona Univ., Tucson) Aug. 1975 17 p refs
(Contract N00014-67-A-0226-0021; NR Proj. 051-552)
(AD-A014650; TR-4) Avail: NTIS CSCL 13/2

Measurements were made of the amounts of 24 components in 24-hour samples of atmospheric particulates collected over a 12-month period in the greater Tucson area. Techniques of pattern recognition were used to examine the data base, which also included meteorological information collected daily over the same period of time. Clustering methods grouped similar components together. Principal Component Analysis showed that most of the variance was contained in only a few dimensions. GRA

N76-17664# Army Construction Engineering Research Lab., Champaign, Ill.
PROCEDURES FOR REVIEWING ENVIRONMENTAL IMPACT ASSESSMENTS AND STATEMENTS FOR CONSTRUCTION PROJECTS Final Report
R. K. Jain, N. L. Drobny, and S. Chatterjee Aug. 1975 28 p refs
(DA Proj. 4A7-62720-A-896)
(AD-A015020; CERL-TR-E-73) Avail: NTIS CSCL 13/2

This report presents systematic procedures designed to assist administrative and staff personnel in quickly and accurately reviewing environmental impact assessments and statements (EIA/EIS). In addition, these guidelines will help the EIA/EIS preparer and reviewer assess the completeness and accuracy of the final document. The report describes the components of the review procedure and includes an example to illustrate its implementation. Project screening factors, suggested factor rating criteria, and methodology for ranking projects on three levels are presented in tabular form to facilitate understanding and application of the review process. Author (GRA)

N76-17665# Naval Civil Engineering Lab., Port Hueneme, Calif.
BIODETERIORATION OF NAVY INSECTICIDES IN THE OCEAN Annual Report, 1 Jul. 1973 - 30 Jun. 1974
Harold P. Vind and C. W. Mathews Jan. 1975 10 p refs
(AD-A007568; AR-4) Avail: NTIS CSCL 08/1

Based on the results of an investigation of the biodeterioration of insecticides in the ocean, it was hypothesized that the water-insoluble chlorinated insecticides are transported in sea water primarily by being absorbed in the fatty cell membranes of microorganisms suspended in the water. The hypothesis predicts that insecticides somewhat less fat-soluble than DDT will not enter the ocean food chain as readily as DDT. They would not be as hazardous as DDT and yet might be just as toxic and persistent. The hypothesis also predicts that insecticides in sewage can be removed with the microbial cells in a primary or secondary treating plant. At the Civil Engineering Laboratory several experiments are underway to determine the validity of the hypothesis. GRA

N76-17666# Battelle Columbus Labs., Ohio. Ecological Research Series.
EXPLORATORY STUDY OF FACTORS AFFECTING AEROSOL FORMATION
David F. Miller Nov. 1974 27 p refs
(Contract EPA-68-02-1217)
(PB-245274/6; EPA-650/3-75-002) Avail: NTIS CSCL 13B

A smog chamber study was completed to provide methodology and preliminary data on the rate of photooxidation of SO2 in environments simulating urban atmospheres. The experimental program included irradiation testing of clean air as well as air containing pollutants at concentration levels typical of those found in urban atmospheres. Results showed the rate of SO2 photooxidation to be unexpectedly as high as 5 percent per hour. Furthermore, the presence of deliberately injected pollutants did not seem to have a decisive effect on the SO2 photooxidation. GRA

N76-17667# Combustion Engineering, Inc., Windsor, Conn.
PROGRAM FOR REDUCTION OF NOx FROM TANGENTIAL COAL-FIRED BOILERS, PHASE 2 Final Report, Jul. 1973 - Mar. 1975
Ambrose P. Selker Jun. 1975 144 p refs

(Contract EPA-68-02-1367)
(PB-245162/3; EPA-650/2-73-005-a) Avail: NTIS HC $6.00 CSCL 13A

This report presents the finding of a project. Phase I of the program consisted of selecting the Alabama Power Company, Barry Station no. 2 steam generator which was modified for the studies performed under Phase II. The work accomplished under Phase II included the design, fabrication, and delivery of an overfire air system for the test unit, the installation of test equipment, planning, and the conducting of baseline, biased firing and overfire air studies for NOx emission control while burning a Kentucky bituminous coal type. These test programs included an evaluation of the effect of variations in excess air, unit slagging, load and overfire air on unit performance and emission levels.
GRA

N76-17668# Southeast Michigan Council of Governments, Detroit.
A MANUAL MODEL TO PREDICT HIGHWAY RELATED CARBON MONOXIDE CONCENTRATIONS Final Report
David A. Doctor May 1975 43 p refs Prepared in cooperation with Michigan State Dept. of State Highways and Transportation
(Contract DOT-FH-MOSHT-74-0613)
(PB-245407/2; S-7501; Paper-15) Avail: NTIS HC $4.00 CSCL 13B

The derivation of a manual model used in predicting highway-related carbon monoxide concentrations is presented and its use in predicting concentrations under different conditions is examined. The model incorporates the variables of meteorology, involving both atmospheric stability and wind, vehicle mix by age and the associated vehicle miles traveled, vehicle type, distinguishing between light and heavy duty vehicles, carbon monoxide emissions by year modified by average link speed, traffic volume, measured for the peak hour and eight hour hourly average, and dispersion factors for both horizontal and vertical directions. With an accurate description of a facility's design, use characteristics and meteorological conditions, very accurate prediction of the carbon monoxide concentrations on or near the facility may be made. These variables and the derivation of the model are discussed in detail, leading in logical order to the assembly and use of the model.
GRA

N76-17669# KLD Associates, Inc., Huntington, N.Y.
DESIGN, DEVELOPMENT, AND FIELD TEST OF A DROPLET MEASURING DEVICE Final Report, Jun. 1973 - Jun. 1974
Hector Medecki, Myron Kaufman, and Daniel E. Magnus Feb. 1975 57 p refs
(Contract EPA-68-02-1309)
(PB-245607/7; EPA-650/2-75-018) Avail: NTIS HC $4.50 CSCL 13B

The design, development, and field testing is described of a concept to measure liquid droplets in the size range from 1 to 600 micrometers. The measurement probe is a platinum wire 5 micrometers in diameter. With the probe electrically heated to a predetermined temperature, changes in the probe resistance are related to the size of the impinging droplets in the gas flow. The electrical signals from the probe are processed and used to classify the droplets into six different size ranges or bins. Two prototypes, consisting of the probe and electronic processing unit, were constructed and tested in the field. Actual droplet distributions and concentrations were measured successfully.
GRA

N76-17670# North Carolina Water Resources Research Inst., Raleigh.
STRATEGIES FOR WATER QUALITY MONITORING
Jabbar K. Sherwani and David H. Moreau Jun. 1975 150 p refs Published as Report ESE-Pub-398
(Contract DI-14-31-0001-4033)
(PB-245765/3; UNC-WRRI-75-107; W76-00178; OWRT-A-065-NC(2); ESE-Pub-398) Avail: NTIS HC $6.00 CSCL 13B

General guidelines are provided for the preliminary design of a water quality monitoring system. The design is defined as the specification of the parameters to be determined, the number and location of sampling stations, and the frequency of sampling. The objectives are the characterization of stream water quality, enforcement of stream standards, and the detection of long-term trends. Principal components analysis is used to identify important water quality parameters and to find the appropriate size of a monitoring network. Impact index based on the probability, severity and frequency of violation, number of direct users of the stream water, predominant use and the size of stream is proposed for determining the priority of location in an enforcement network.
GRA

N76-17671# Biospherics, Inc., Rockville, Md.
CONTRIBUTIONS OF URBAN ROADWAY USAGE TO WATER POLLUTION Final Report, Apr. 1972 - Sep. 1974
Donald G. Shaheen Mar. 1975 359 p refs
(Contract EPA-68-01-0197)
(PB-245854/5; EPA-600/2-75-004) Avail: NTIS HC $10.50 CSCL 13B

Street surface contaminants are deposited on roadways from many sources within an urban area. Industrial operations, land use activities, fallout of air pollutants, roadway usage and other activities contribute to the loading of particulates on urban roadways. These materials are then carried into receiving waters by storm runoff where they constitute a substantial portion of the overall water pollution problems of cities. Metropolitan Washington, D.C., with its low background of industrial emissions, was the area chosen for study of contributions of motor vehicle usage to urban roadway loading factors. Specific roadway study sites within this area were selected so as to provide minimal interference from nontraffic-related land use activities and thus isolate, as much as possible, the traffic-related depositions.
GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N76-17672 Northwestern Univ., Evanston, Ill.
AT REST EARTH PRESSURE OF CLAYS DURING ONE-DIMENSIONAL CONSOLIDATION Ph.D. Thesis
Mohamed Salah Abdelhamid 1975 412 p
Avail: Univ. Microfilms Order No. 75-29558

The at rest earth pressures that develop during the process of K consolidation and subsequent unloading and loading cycles are investigated. Two clay slurries with different controlled chemistries (flocculated and dispersed) were consolidated under different values of the major (axial) principal stress in large-diameter, rigid, cylindrical slurry consolidometers, and the axial deformations, pore pressures, and both axial and radial stresses were measured directly, thereby providing a continuous record of the stress and strain history of each sample. After completion of consolidation, the fabric of the sample was identified by the combined use of scanning electron microscopy, optical microscopy, and X-ray diffractometry. The processes of consolidation were then analyzed and interpreted in terms of the predominant clay fabrics and the micromechanisms that prevail during the different loading-unloading cycles. The initial fabric of the clay slurry was found to be highly controlled by the chemistry of the kaolin-water-solute system, and particle orientation was increased as consolidation progressed.
Dissert. Abstr.

N76-17673 Colorado State Univ., Fort Collins.
SIMULATION OF GRAVITATIONAL WATER MOVEMENT IN SOIL Ph.D. Thesis
Narayanaswamy Krishnamurthi 1975 138 p
Avail: Univ. Microfilms Order No. 76-4315

A mathematical model is developed using the transient soil moisture data which simulates the movement of gravitational water in partially saturated soil. The time distribution of natural groundwater recharge is evaluated using this simulation model. A method for determination of hydraulic properties of soil from transient soil moisture data is developed. The method of simulation capitalizes on the phenomenon that the moisture content of unsaturated soil below the zone of influence of evapotranspiration varies in the linear range of the pressure-saturation curve.

The equation developed to describe the flow of water in unsaturated soil is modified according to this linear relationship. Relationships of soil moisture diffusivity and unsaturated hydraulic conductivity as a function of moisture content are established. The modified equation detects the water flow even under constant soil moisture conditions. Dissert. Abstr.

N76-17674 California Univ., San Diego.
METEOROLOGICAL EXCITATION OF THE EARTH'S WOBBLE Ph.D. Thesis
Clark Roland Wilson 1975 116 p
Avail: Univ. Microfilms Order No. 76-2324

The estimation of the Chandler frequency and dissipation from observations of wobble is accomplished using the method of maximum likelihood. In addition, estimates are derived of the power spectrum of the wobble excitation near the Chandler frequency and of the noise level in the data. The estimation procedure takes explicit account of the noise and uses simulated polar motion time series in a Monte Carlo method to remove biases from the estimates and establish intervals of confidence. The meteorological sources of wobble excitation are examined, including all the known significant contributions due to air and water motion. It is found that the annual wobble is not fully explained by meteorological observation, and that this is caused by errors in the meteorological estimates rather than by error in the polar motion obervations. Dissert. Abstr.

N76-17675*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
NEOTECTONIC TRANSVERSE STRUCTURES OF THE TYAN-SHAN AND THEIR MANIFESTATION ON SPACE PHOTOGRAPHS
V. I. Makorov and L. I. Solovyeva Washington NASA Feb. 1976 16 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Geol. i Razvedka (Moscow), no. 2, 1975 p 10-18
(Contract NASw-2789)
(NASA-TT-F-16851) HC $3.50 CSCL 08E

The structural and geomorphological analysis of the Tyan'-Shan' relief in conjunction with the deciphering of space photographs has shown almost identical value of closely conjugated longitudinal and cutting directions which were similarly evident in the morphology of fold and boulder structural forms and rupture disturbances of different order-from planetary to local. However, in different Tyan'-Shan' areas or within one area but in different stages of the tectonic development, these directions were manifested in such a way that one of them was the main direction and others were secondary and formed structural details. But in all the combinations, often varying in time, they have inevitably accompanied each other and are closely connected genetically. Author

N76-17676*# Scientific Translation Service, Santa Barbara, Calif.
MEASUREMENTS OF THE AEROSOL SIZE DISTRIBUTION OVER THE ATLANTIC
Ruprecht Jaenicke, Christian Junge, and Hans Joachim Kanter Washington NASA Feb. 1976 47 p refs Transl. into ENGLISH of Meteor, Forsch.-Ergebnisse, Pt. B. (West Ger.), no. 7, Dec. 1971 p 1-20
(Contract NASw-2791)
(NASA-TT-F-16897) Avail: NTIS HC $4.00 CSCL 04A

During the third part of the Atlantic Expedition 1969 from 10 deg S to 60 dég N along 30 deg W, measurements of the complete size distribution of atmospheric aerosols over the whole size range from about .000001 to 0.1 mm radius were made. North of the equator the ship passed through the air masses of West African origin and the influence of Sahara dust on the marine aerosols could be documented in a unique way. Of special interest is the observation that the size distribution extends to very small particles, suggesting continuous aerosol production over the ocean. Author

N76-17677*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
A CATALOG OF ATMOSPHERIC DENSITIES FROM THE DRAG ON FIVE BALLOON SATELLITES
L. G. Jacchia and J. W. Slowey 29 Aug. 1975 423 p refs
(Grant NGR-09-015-002)
(NASA-CR-146412; SAO-Special-Rept-368) Avail: NTIS HC $11.00 CSCL 04A

A catalog of atmospheric densities derived for the drag on five balloon satellites is presented. Much of the catalog was based on precisely reduced Baker-Nunn observations and, for that reason, provides much improved time resolution. The effect of direct solar radiation pressure was precisely evaluated, and that of terrestrial radiation pressure was included in every case. The interval covered for each satellite varies between 3.1 and 7.6 years, with the data extending from early 1961 to early 1973. Author

N76-17678# Weapons Research Establishment, Salisbury (Australia).
PARAMETERS OF THE LOWER THERMOSPHERE FROM OBSERVATIONS ON ROCKET RELEASED VAPOUR CLOUDS
K. H. Lloyd, C. H. Low, and R. I. MacLeod Apr. 1975 39 p refs
(WRE-TN-1403(WR/D)) Avail: NTIS HC $4.00

Results are presented of ground based observations on vapor clouds released from rockets fired at Woomera. The wind profile, density, and temperature of the thermosphere were determined from the drift, expansion, and spectrum of each release. The data are compared with predictions of appropriate model atmospheres, and with current ideas of thermospheric properties. Author

N76-17679# Weapons Research Establishment, Salisbury (Australia).
NIGHT-TIME TRANSPORT OF LYMAN ALPHA RADIATION IN THE MESOPAUSE AND LOWER THERMOSPHERE
G. G. OConnor Apr. 1975 13 p refs
(WRE-TN-1360(WR/D)) Avail: NTIS

The transport and absorption of Lyman alpha radiation in the night-time atmosphere is considered. Radiation in the central part of the spectrum of this emission is subject to both resonance scattering and pure absorption. A treatment is given of the radiative transport of this component in the mixture of scattering and absorbing species which is found in the mesopause and lower thermosphere. The results have a form which is particularly useful in analysis of absorption profiles measured in this region. This approach enables the densities of scatterer and absorber, in this case atomic hydrogen and molecular oxygen, to be deduced from measured profiles. The results of the treatment are general and could be applied to mixtures other than of the atmospheric species considered. Author

N76-17680*# Scientific Translation Service, Santa Barbara, Calif.
ON THE PERIODICITY OF SEISMIC ACTIVITY DURING THE LAST ONE AND A HALF TO TWO THOUSAND YEARS (BASED ON THE EXAMPLE OF ARMENIA)
G. P. Tamrazyan Washington NASA Feb. 1976 25 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (USSR), no. 1, 1962 p 76-85
(Contract NASw-2483)
(NASA-TT-F-16717) Avail: NTIS HC $3.50 CSCL 08K

The periodicity of seismic activity in Armenia over the last one and a half thousand years was examined. Based on the data considered, seismic periods of a duration of 90-140 years were established. Author

N76-17681*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE EFFECT OF REMOTE ZONES ON THE ACCURACY OF EVALUATING THE MOLODENSKY
James J. Buglia Jan. 1976 22 p refs
(NASA-TM-X-72798) Avail: NTIS HC $3.50 CSCL 08E

An analytical method is presented for determining the error in computing the gravity anomaly from the Molodensky integral if geoidal undulation data in remote zones are neglected. The error is given in terms of the usual degree variance and a set of parameters which are functions only of the size of the area in which undulation data are taken. A numerical calculation using Kaula's degree variances indicates that it is necessary to integrate the Molodensky integral over approximately a hemisphere in order to reduce the effect of neglected data to the order of 1 milligal in the computation of gravity anomaly. Author

N76-17682*# Texas A&M Univ., College Station. Dept. of Physics.

RADIANCE, POLARIZATION, AND ELLIPTICITY OF THE RADIATION IN THE EARTH'S ATMOSPHERE

Stephen J. Hitzfelder, Gilbert N. Plass, and George W. Kattawar 2 Feb. 1976 51 p refs

(Grant NGR-44-001-117)

(NASA-CR-146385; Rept-24) Avail: NTIS HC $4.50 CSCL 04A

The complete radiation field including polarization is calculated for a model of the real atmosphere by the matrix operator method. The radiance, direction and amount of polarization, and ellipticity are obtained at the top and bottom of the atmosphere for three values of the surface albedo (0; 0.15 0.90) and five solar zenith angles. Scattering and absorption by molecules (including ozone) and by aerosols are taken into account together with the variation of the number density of these substances with height. All results are calculated for both a normal aerosol number and a distribution which is one-third of the normal amount at all heights. The calculated values show general qualitative agreement with the available experimental measurements. The position of the neutral points of the polarization in the principal plane is a sensitive indicator of the characteristics of the aerosol particles in the atmosphere, since it depends on the sign and value of the single scattered polarization for scattering angles around 20 deg and 160 deg for transmitted and reflected photons respectively.

Author

N76-17683*# Old Dominion Univ., Norfolk, Va.

INVESTIGATION OF AEROSOL CHARACTERISTICS AND THEIR MEASUREMENT Final Report, 15 Aug. 1974 - 15 Aug. 1975

Adarsh Deepak Mar. 1976 8 p refs

(Grant NsG-1090)

(NASA-CR-146398; PGSTR-AP76-23) Avail: NTIS HC $3.50 CSCL 04A

Various techniques for the measurement of aerosol properties are described. Methods considered include: solar aureole photographic technique; densitometric techniques; and video electronic isodensity mapper. Other topics briefly discussed include: multiple scattering experiment; multiple scattering computer program; the generation of the Mie theory results; and the NASA/OAST technology workshop. J.M.S.

N76-17684# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

STUDY OF THE TURBULANCE IN STRATIFIED AIR LAYERS IN BRAZIL [ESTUDO DE TURBULENCIA EM UMA ESTRATIFICACAO ESTAVEL PERTO DO SOLO]

P. V. DeAzevedo Jan. 1975 83 p refs In PORTUGUESE

(INPE-614-LAFE) Avail: NTIS HC $5.00

Wind and temperature profiles for a wide range of stable conditions in the surface boundary layer are analyzed in the context of the Monin-Obukhov similarity theory. The diabatic mean profile forms are presented. The Monin-Obukhov universal theta functions for momentum and heat vary linearity over the entire stability range of the observation. The ratio of eddy diffusivity coefficients for heat and momentum is evaluated from theta functions and it is found to be equal to 1.35 for near neutral conditions. This ratio decreases with increase of instability and height. It is in agreement with a formula proposed by Businger from fluctuation measurements of wind and temperature. It is shown that the log-linear relation fits the observations well over a selected range of stability (i.e., Richardson number range between 0.004 to 0.21). The Deacon power law approach is reconciled with the similarity theory of Monin-Obukhov. Turbulent dissipation rates are calculated from profiles. It appears that the vertical divergence in the energy balance of both velocity and temperature is of negligible importance. Author

N76-17685*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GRAVSAT/GEOPAUSE COVARIANCE ANALYSIS INCLUDING GEOPOTENTIAL ALIASING

David W. Koch Oct. 1975 26 p refs

(NASA-TM-X-71057; X-932-75-222) Avail: NTIS HC $4.00 CSCL 08N

A conventional covariance analysis for the GRAVSAT/GEOPAUSE mission is described in which the uncertainties of approximately 200 parameters, including the geopotential coefficients to degree and order 12, are estimated over three different tracking intervals. The estimated orbital uncertainties for both GRAVSAT and GEOPAUSE reach levels more accurate than presently available. The adjusted measurement bias errors approach the mission goal. Survey errors in the low centimeter range are achieved after ten days of tracking. The ability of the mission to obtain accuracies of geopotential terms to (12, 12) one to two orders of magnitude superior to present accuracy levels is clearly shown. A unique feature of this report is that the aliasing structure of this (12, 12) field is examined. It is shown that uncertainties for unadjusted terms to (12, 12) still exert a degrading effect upon the adjusted error of an arbitrarily selected term of lower degree and order. Finally, the distribution of the aliasing from the unestimated uncertainty of a particular high degree and order geopotential term upon the errors of all remaining adjusted terms is listed in detail. Author

N76-17686*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GRAVIMETRIC INVESTIGATIONS ON THE NORTH AMERICAN DATUM (1972 - 1973)

R. S. Mather Dec. 1975 89 p refs Submitted for publication

(NASA-TM-X-71058; X-921-75-244) Avail: NTIS HC $5.00 CSCL 08N

All the available unclassified gravity data on the North American Datum (NAD) and in the surrounding oceans was assembled late in 1972 for the investigation of the gravity field in North America and its relation to North American Datum 1927 (NAD 27). The gravity data in Canada and the United States was compiled on a common datum compatible with the International Gravity Standardization Network 1971 (IGSN 71). The variation in the error of representation in the region is studied along with the correlation characteristics of gravity anomalies with elevation. A free air geoid (FAG 73) was computed from a combination of surface gravity data and Goddard Earth Model (GEM) 4 and this was used as the basis for the computation of the non-Stokesian contributions to the height anomaly. The geocentric orientation parameters obtained by this astrogravimetric method are compared with those obtained by satellite techniques. The differences are found to be no greater than those between individual satellite solutions. The differences between the astrogravimetric solution and satellite solutions GSFC 73 and GEM 6 are studied in detail with a view to obtaining a better understanding of these discrepancies. Author

N76-17687*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

VARIATIONAL ELECTRIC FIELDS AT LOW LATITUDES AND THEIR RELATION TO SPREAD F AND PLASMA IRREGULARITIES

J. A. Holtet, N. C. Maynard, and J. P. Heppner Jan. 1976 45 p refs Submitted for publication

(NASA-TM-X-71065; X-625-76-24) Avail: NTIS HC $4.00 CSCL 08N

Recordings from OGO 6 show that electric field irregularities are frequently present between + or - 35 deg geomagnetic latitude in the 2000 - 0600 local time sector. The signatures are very clear, and are easily distinguished from the normal AC background noise, and whistler and emission activity. The spectral appearance of the fields makes it meaningful to distinguish between 3 different types of irregularities: strong irregularities, weak irregularities, and weak irregularities with a rising spectrum. Strong irregularities seem most likely to occur in regions where gradients in ionization are present. Changes in plasma composition, resulting in an increase in the mean ion mass, are also often observed in the irregularity regions. Comparison with ground based ionosondes indicates a connection between strong irregularities and low latitude spread F. A good correlation is also present between strong fields and small scale fluctuations in ionization, delta $N/N > 1$ percent. From the data it appears as if a gradient driven instability is the most likely source of the strong irregularities. Author

N76-17688# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. Ionospheric Physics Lab.

ITERATIVE RAY-TRACING SIMULATION OF MINIMUM GROUP-PATH TRACES IN SWEPT-FREQUENCY BACK-SCATTER IONOGRAMS Environmental Research Papers
Ming S. Wong 2 May 1975 22 p refs
(AF Proj. 5631)
(AD-A014782; AFCRL-TR-75-0241; AFCRL-ERP-509) Avail: NTIS CSCL 04/1

Swept-frequency traces of minimum group-path length in backscatter-radar ionograms, computed for a measured three-dimensional electron distribution in the midnight sector of the polar ionosphere, are presented. Also presented are minimum group-path traces computed for trial electron distributions chosen to simulate the group-path traces of the measured electron distribution, and to show the effects on the group-path traces as consequences of variations made upon major features of the trial electron distributions. GRA

N76-17689# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
TRANSFER OF HEAT, MOISTURE IN SEASONALLY FREEZING GROUND OF ROAD BEDS
V. A. Lukina and B. V. Uvarov Sep. 1975 14 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Lesn. Zh. (Archangelsk), v. 17, no. 4, 1974 p 51-58
(AD-A015553; CRREL-TL-487) Avail: NTIS CSCL 13/2

In this article a method is furnished for solving differential equations in partial derivatives. The method describes in a unidimensional task the process of heat and moisture exchange taking place in roadbeds and road surfaces. The solution was obtained using a digital application of conversion. Using an 'Nairi-S' electronic computer, the method makes it possible to determine the winter redistribution of moisture in the ground of roadbeds and also the amount of heaving. The results of the specific computations carried out agrees rather well with the test results. GRA

N76-17690# Wyoming Univ., Laramie. Dept. of Physics and Astronomy.
GLOBAL MONITORING OF STRATOSPHERIC AEROSOL, OZONE AND WATER VAPOR Final Report
D. J. Hofmann, J. M. Rosen, and T. J. Pepin Sep. 1975 11 p refs
(Contract N00014-70-A-0266-0005)
(AD-A015287; GM-34) Avail: NTIS CSCL 04/1

Data obtained during a 3-1/2 year stratospheric monitoring program are reviewed in terms of reports issued and publications. GRA

N76-17691# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
USA CRREL SNOW AND ICE TESTING EQUIPMENT
Herbert Ueda, Paul Sellmann, and Gunars Abele Sep. 1975 20 p refs
(AD-A015512; CRREL-SR-146) Avail: NTIS CSCL 08/12

The paper summarizes available information on the history, development, and application of three items of special equipment designed or modified by USA CRREL for testing and sampling snow and ice. These items have become universally known and accepted, providing measurement techniques that are used, in some cases, on an international basis. The equipment described includes the 3-in. ice coring auger, the ice thickness kit, and the Rammsonde. GRA

N76-17692# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
INVESTIGATION OF THE INFLUENCE OF TIME OF WORKING LOAD ON BEARING CAPACITY OF SHEET
A. E. Ikunin Dec. 1974 25 p refs Transl. into ENGLISH of the book "Novosibirskii Inst. inzhenerov zheleznodoro zhnogo transporta" USSR, 1970 p 1-22
(AD-A004004; CRREL-TL-426) Avail: NTIS CSCL 08/12

The deformation and stressed state of an ice cover is discussed with an allowance for the time of load influence. The available experimental data and the existing mathematical concepts are analyzed along with the results from theoretical and experimental studies. Rigorous relationships of load effect are developed and the actual engineering problems originating during the employment of an ice cover as a construction-assembly area are reviewed. GRA

N76-17693# Geological Survey, Reston, Va.
EVALUATION OF NATURAL ISOTOPES IN GROUND-WATER SYSTEMS Final Report, 1 Jul. 1972 - 30 Jun. 1975
F. J. Pearson, Jr. Jul. 1975 20 p refs Sponsored in part by AROD
(AD-A015555; ARO-10790.1-EN) Avail: NTIS CSCL 08/8

The project has studied the use of various isotopes which occur naturally in ground-water systems in order to determine ages and flow rates of ground water and to aid in understanding geochemical reactions between ground waters and the minerals and gases with which they come in contact. Detailed reports of the studies including carbon, oxygen, sulfur and hydrogen isotope work in a number of aquifers are in preparation. GRA

N76-17694# Lamont-Doherty Geological Observatory, Palisades, N.Y.
THE OCEANOGRAPHIC PROGRAM FOR THE ARCTIC ICE DYNAMICS JOINT EXPERIMENT
Kenneth Hunkins Mar. 1975 24 p refs
(Contract N00014-67-A-0108-0039; NR Proj. 307-359)
(AD-A007567; TR-2) Avail: NTIS CSCL 08/12

The overall program of the Arctic Ice Dynamics Joint Experiment is reviewed. Data on ice stress and strain gathered from a multistation array is used to formulate a dynamic ice model which can be coupled with numerical global atmospheric and oceanic models to represent the behavior of a fluid earth. Measurement of ocean currents, salinity, and temperature in the upper layers of the Arctic Ocean is discussed along with calibration of instruments and data management. J.M.S.

N76-17695# Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
MORPHOLOGY OF AN ARCTIC RIVER BAR
Lawrence S. McKenzie, III and Harley J. Walker Nov. 1974 41 p refs
(Contract N00014-69-A-0211-0003; NR Proj. 388-002)
(AD-A003586; TR-172) Avail: NTIS CSCL 08/6

The structural and temporal variations of microrelief features of Putu bar were investigated during the 1971 field season, which lasted from before the initiation of snowmelt in late winter to late summer. Each feature was classified as to when it formed, how long it persisted, and what processes were involved. GRA

N76-17696# Ohio State Univ., Columbus. Dept. of Geodetic Science.
COMBINATION OF AERIAL GRAVIMETRY AND GRADIOMETRY Interim Report
Helmut Moritz Jul. 1975 78 p refs
(Contract F19628-72-C-0120; AF Proj. 8607)
(AD-A015170; DGS-223; AFCRL-TR-75-0378; SR-25) Avail: NTIS CSCL 08/5

This report considers the use of a combined accelerometer and gradiometer system for measuring first and second order gradients of the earth's gravitational potential. In this way it is possible to rigorously separate genuine gravitational effects from inertial disturbances, in both first and second order gradients. The theory is developed at length. Accuracy studies comprise the error propagation along a flight profile as well as the error of interpolation between the profiles. By means of least-squares collocation it is investigated how the additional use of second order gradients improves the interpolation of gravity. Numerical estimates are given. GRA

N76-17697# Woods Hole Oceanographic Institution, Mass.
WHOI GEOLOGICAL SAMPLES DATA FILE. VOLUME 1: 1957 TO 1973
Alan H. Driscoll and Susan M. Rush Jul. 1975 288 p
(Contract N00014-74-C-0262; Grant NSF DES-74-06463; NR Proj. 083-004)
(AD-A015091; WHOI-75-37-Vol-1) Avail: NTIS CSCL 08/10

The sample information contained in Volume I of the W.H.O.I. Geological samples Data File represents the first phase in the digitization of the Woods Hole geological samples collection, and includes all samples collected between 1957 and 1973.

Additional volumes will be produced at regular intervals as the curation and description of subsequent samples are completed. The volume is designed as a quick reference to the samples within the collection and has been compiled using two of the listing formats available with the MUDDIE Program. These two listings are presented in Sections I and II of this volume. Section I contains an abbreviated listing of the samples in order of their occurrence withing specific Marsden squares. Section of the volume contains a full listing of the samples, arranged by ship and cruise. Appropriate comments relating to specific samples have been included. Within Section II, individual poston cores are represented by two entries. GRA

N76-17698# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

ELECTRICAL POTENTIALS IN FREEZING SOLUTIONS AND THEIR EFFECT ON MIGRATION

R. I. Korkina Oct. 1975 20 p refs Transl. into ENGLISH from the Monograph "Protsessy Teplo i Massoobmena v Merzlykh Gornykh Prordakh" Moscow, Nauka, 1965 p 56-65

(AD-A015554; CRREL-TL-490) Avail: NTIS CSCL 08/12

Electrical potential originating during gradual cooling of doubly distilled water, weak salt solutions, and clay suspensions was studied experimentally in relation to moisture migration in soil during freezing. The experimental procedure consisted in keeping the sample-filled flasks, insulated on all sides but the bottom, under definite minus temperature conditions and observating the variation of the magnitude and sign of potential in time. Curves relating these variations to the distance between the measuring electrode and the cooling surface, and to cooling time were plotted from the reading obtained. Interpretation of the results indicated that a change in water structure preceeding its freezing was the cause of origin of electrical potential and that this effect on water migration in freezing soil is dependent on the concentrations of salts dissolved in the soil moisture, the mineralogical composition of colloidal particles suspended in the solution, and the composition of exchange cations on the surface of these particles. GRA

N76-17699# Stanford Research Inst., Menlo Park, Calif.

DYNAMIC PROPERTIES OF ROCK REQUIRED FOR PREDICTION CALCULATIONS Final Report, 18 Jan. 1973 - 31 Aug. 1974

C. F. Petersen and J. T. Rosenberg Nov. 1974 57 p refs (Contract DNA001-73-C-0105; DNA Proj. NWED-QAXS; SRI Proj. PYU-2314)

(AD-A007440; DNA-3579F) Avail: NTIS CSCL 08/7

Dynamic loading and unloading curves were measured to 29 kbar in wet and dry tuff from the Nevada Test Site, wet and dry sandstone from the mixed company site, and wet soil from the Essex site (in Louisianna). The curves were obtained using multiple embedded gages that recorded particle velocity and/or stress histories at up to four different depths in gas gun impact experiments. The Fowles - Williams method was used to generate compression and release paths from these records. In dry tuff at low pressures, the stress wave is quite dispersive, and at higher pressures, it is much less so. Yielding occurs at about one kbar in dry tuff and at about four kbar in dry sandstone. Dispersion, yielding, and permanent compaction were less evident in the experiments with water-saturated standstone. In the Essex soil experiments, the main feature observed was the amount of permanent compaction, which reflects the degree of water saturation. No indication of precursor was seen in this low-strength material. Author (GRA)

N76-17700# Terra Tek, Inc., Salt Lake City, Utah.

SOME RECENT DEVELOPMENTS IN FRACTURE MECHANICS

Rodney J. Clifton 13 Nov. 1974 34 p refs (Contract DNA001-74-C-0047; DNA Proj. NWED-QAXS-B047) (AD-A007439; TR-73-70; DNA-3502T) Avail: NTIS CSCL 08/7

Recent developments in fracture mechanics, both static and dynamic, are reviewed. These results are presented in order to spur exploitation of fracture mechanics in determining fracture criteria for rocks. Such considerations are important to improve computation prediction of ground motion due to explosions occurring at or near the earth's surface as well as evaluation of containment of gas in a nuclear cavity. GRA

N76-17701# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

INTERPRETATION OF YOUNG ICE FORMS IN THE GULF OF ST. LAWRENCE USING SIDE-LOOKING AIRBORNE RADAR AND INFRARED IMAGERY

Moira Dunbar and W. F. Weeks Jul. 1975 49 p refs (AD-A015457; CRREL-RR-337) Avail: NTIS CSCL 08/12

Ice conditions during mid-January 1974 in the Gulf of St. Lawrence and in the estuary as far upstream as Rimouski are described using side-looking airborne radar, infrared and photographic imagery. The interpretations were verified by simultaneous surface observations on the ice by investigators operating from the CSS Dawson. The ice examined was undergoing rapid drift and deformation and showed a wide variety of thin ice (0-40 cm) features formed under the influence of strong winds and currents. These observations should serve as a guide in interpreting ice conditions in similar areas where ground truth data are not available. GRA

N76-17702# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

FIRST RESULTS OF INVESTIGATIONS OF THE WATER BALANCE IN RIVERS IN THE UPPER KOLYMA BASIN

A. S. Ruznetsov Feb. 1975 36 p refs Transl. into ENGLISH from Gidrometeorol. Observ., Sb. Rabot (Magadan), no. 2, 1969 p 98-121

(AD-A004006; CRREL-TL-454) Avail: NTIS CSCL 08/8

Water balance investigations were conducted for eight water-collecting areas in the upper Kolyma basin during 1967-1968. There is a very definite pattern in the change in individual water balance components and the relationship between them in dependence on the nature of the underlying surface and the extent of the water-collecting areas. There is a very distinct role of talus in the water balance as a factor causing an additional influx of moisture in the river balance. From these investigations they determined the need for developing a method for instrumental determination of evaporation and condensation from talus deposits, measurement of moisture reserves in peaty ground and measurement of evaporation from the soil applicable to the conditions of continuous occurrence of permafrost. Author (GRA)

N76-17703# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

THERMAL AND MECHANICAL INTERACTION OF FROZEN ROCK WITH ENGINEERING INSTALLATION

S. E. Grechishchev Nov. 1974 110 p refs Transl. into ENGLISH from Tr. Vses. Nauch.-Issled. Inst. Gidro-Geologii Inzhenernoi Geologii (USSR), no. 55, 1973 p 1-121

(AD-A004005; CRREL-TL-449) Avail: NTIS CSCL 08/7

The articles presented are devoted to the questions of engineering geocryology. The two types of articles included are: thermal and mechanical interaction of mine working with surrounding rocks, and temperature stresses and strains in earth dams. The first group of reports is devoted to forecasting heat and mass exchange in mine workings having a refrigerating - storage purpose. The second set of articles is devoted to the slightly - studied question concerning temperature stresses and strains in earth dams and in a soil mass during winter. Data on the theoretical and laboratory studies and also on the full scale observations of the temperature deformations of frozen soils is included. Author

N76-17704# National Oceanic and Atmospheric Administration, Boulder, Colo. Space Environment Lab.

A COMPUTER PROCESSING METHOD FOR REAL-TIME MAGNETOMETER OBSERVATIONS

Larry J. Gardner and Charles E. Hornback May 1975 8 p refs

(COM-75-11403/3; NOAA-TM-ERL-SEL-40; NOAA-75091806) Avail: NTIS HC $3.50 CSCL 08N

A computer method that has been developed for estimating the K-indices and gamma deviations of a ground-based magnetometer is discussed. The results give automated, real-time observations that are suitable for operational applications. GRA

N76-17705# Transportation Research Board, Washington, D.C.
PAVEMENT AND SOIL CHARACTERISTICS
C. L. Monismith 1975 90 p refs Prepared for 54th Ann. Meeting of the Transportation Research Board
(PB-245230/8; TRB/TRR-537; ISBN-0-309-02388-2) Avail: NTIS HC $5.00 CSCL 13B

Information on soil characteristics useful for pavement design is included which is of interest to soil engineers and highway designers. An estimate of the contribution of the subgrade to the total permanent deformation of the pavement structure; a presentation of a new method of predicting permanent deformation of pavements through the use of mean normal stress and octhedral stress; a discussion of the four most commonly used materials for slubbases; a review of the use of the shell procedure for design of unbound granular material; a discussion of the results of an investigation of the effects of cycling confining stress; a presentation of a method for estimating the constrained soil modulus by use of compaction test parameters and field density results; and a presentation of a means of deriving satisfactory tangent moduli and Poisson's ratio for a given stress level from standard triaxial compression test data. GRA

N76-17706# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
A STUDY OF COMMUNICATIONS FOR THE SEISMIC DATA COLLECTION NETWORK Final Report, 1 Aug. 1974 - 30 Jun. 1975
Howard W. Briscoe 30 Jun. 1975 132 p refs
(Contract F08606-75-C-0017; ARPA Order 2551)
(AD-A016604; BBN-3109) Avail: NTIS CSCL 17/10

This report presents the results of studies performed to support the implementation of a worldwide seismic data collection network using a mix of ARPA Network and leased line communications. Host level protocols for the ARPA Network links are specified. An analysis of the traffic generated by the seismic data subnet identified potential limits imposed by the bandwidth and buffer capacity at two nodes of the network. Operational monitoring and diagnostic procedures are recommended. A backup plan for the system design is developed in case error rates in local communications to the seismic stations are excessive. Design specifications for the Seismic Private Line Interface computer for interfacing existing seismic station controllers to the ARPA Network are included as an appendix. GRA

N76-17707# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
DESIGN AND POTENTIALS OF THE CALIFORNIUM-252 RADIATION FACILITY AT WES Final Report
Jack T. Lewis and Ellis L. Krinitzsky Sep. 1975 70 p refs
(DA Proj. 4A0-61101-A-91D)
(AD-A016787; AEWES-Misc-Paper-S-75-26) Avail: NTIS CSCL 08/13

A facility was designed and subsequently has been built for the utilization of californium-252 in research on moisture, density, and other properties of soil and rock in relation to their engineering characteristics. Preliminary testing shows good correlations between neutron radiation and the quantification and distribution of moisture both in soil slices and steel-encased undisturbed soil samples. Such data, when used in conjunction with X-ray studies, are valuable in furthering the knowledge and understanding of soil and rock behavior. Continued research will refine techniques for more detailed study of properties of earth materials. Detailed plans of the facility and its components are given in Appendix A. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N76-17708 State Univ. of New York, Albany.
THE FATE OF CERTAIN ATMOSPHERIC TRACE GASES AND THEIR INTERACTIONS WITH THE WATER CYCLE Ph.D. Thesis
Glenn Kwok-Luen Yue 1975 157 p
Avail: Univ. Microfilms Order No. 76-1901

A theoretical model describing the general interaction between atmospheric trace gases and cloud droplets is proposed. The model includes both the gas phase and liquid phase oxidation of trace gases. This model predicts that pH value of cloud droplets, the concentration of sulfate in cloud droplets, and the amount of HCL released from the cloud. The relative importance of these two mechanisms depends on the size distribution of cloud droplets, the time duration of the reaction, the relative abundance of trace gases, and the assumed oxidation rate. The pH value and the concentration of sulfate in cloud droplets as a function of the cloud droplet size distribution are calculated. Also calculated is the average pH value of the cloud as a function of the reaction time. The results show that the inclusion of the gas phase oxidation process can further lower the pH value of the cloud droplets below levels predicted by previous model calculations. The effects of temperature on the average pH value of the cloud, and the concentration of sulfate in cloud droplets are also discussed.
Dissert. Abstr.

N76-17709 Deutscher Wetterdienst, Offenbach am Main (West Germany).
ANNALS OF METEOROLOGY NO. 9 [ANNALEN DER METEOROLOGIE NR. 9]
1974 162 p refs Partly in ENGLISH and partly in GERMAN; ENGLISH summaries Proc. of a Meteorol. Symp., Bad Homburg, West Ger., 27-29 Mar. 1974
Avail: Issuing Activity

Topics presented include: GARP planning and objectives, anthropogeneous climate and weather modifications, numerical short and medium term weather forecasting, and objectivation of local weather forecasts. For individual titles, see N76-17710 through N76-17735.

N76-17710 Wisconsin Univ., Madison.
ANTHROPOGENEOUS INFLUENCE ON CLIMATE AND METEOROLOGICAL PARAMETERS [ANTHROPOGENE BEEINFLUSSUNG VON KLIMA UND WITTERUNGSPARAMETERN]
Heinz Lettau *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 9-13 refs In GERMAN (For availability see N76-17709 08-47)

A mathematical method is proposed for quantitatively dealing with climatic changes, based on earth surface temperature, soil moisture, energy balances for certain parts of the earth, and time as a variable. Climate calculations according to this method have been named climatonomy, and this procedure has been used for determining anthropogeneous climate modifications.
ESA

N76-17711 Deutscher Wetterdienst, Offenbach am Main (West Germany).
GARP: DEVELOPMENT OF AN INTERNATIONAL PROGRAM [GARP, ENTWICKLUNG EINES INTERNATIONALEN PROGRAMMES]
F. Moeller *In its* Ann. of Meteorology No. 9 1974 p 15-21 In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The origin of GARP is described from its conception to the planning stage. The formation of World Weather Watch, of ICSU (Committee of Atmospheric Sciences), and of COSPAR Working Group 6, are mentioned, as well as their scientific plans. The Global Experiment is described as a future development with all of its observational subsystems. Author (ESA)

N76-17712 Bonn Univ. (West Germany). Inst. fuer Meteorologie.
INSTABILITY AND ANTHROPOGENEOUS MODIFICATION OF THE CLIMATE [INSTABILITAET UND ANTHROPOGENE MODIFIKATION DES KLIMAS]
H. Flohn *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 25-31 refs In GERMAN (For availability see N76-17709 08-47)

The long term variations of the climate are discussed based on the theory developed by E. Lorenz, and some examples are given. In addition, the climatic variations and modifications as a result of the human influence on the budget of nature in the geophysical system, atmosphere-ocean-ice, are dealt with. An

interpretation is proposed for the recent cooling-off of the Arctic. ESA

N76-17713 Bonn Univ. (West Germany). Inst. fuer Meteorologie.

SPECTRAL SOLUTION OF ZONE AND TIME AVERAGED CLIMATIC EQUATIONS [SPEKTRALE LOESUNG ZONAL UND ZEITLICH GEMITTELTER KLIMAGLEICHUNGEN]

W. Wergen *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 33-36 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

Model equations are presented for a steady state, zonally averaged climatic model. In a spectral solution procedure the eigen functions have to fulfill the meteorological and geographical boundary conditions. After a discussion of these conditions and of the matching functions and eigen values, the system of the nonlinear, inhomogeneous partial differential equations is reduced to an algebraic system for the unknown amplitudes. This system is solved by Newton's method. Some results of these computations are discussed. Author (ESA)

N76-17714 Bonn Univ. (West Germany). Inst. fuer Meteorologie.

THE DIABATIC RADIATIVE DRIVING FUNCTION FOR A CLIMATIC MODEL [DIE DIABATISCHE STRAHLUNGSANTRIEBSFUNKTION FUER EIN KLIMAMODELL]

W. Peyinghaus and H. C. Korff *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 37-39 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The equations of radiative transfer in the long wave spectral range and the exponential law of Bouguer/Lambert in the solar spectrum are used to compute the vertical profile of the radiation balance Q. The divergence of Q leads to the radiative hearing of the atmosphere. In the equations mentioned above, the parameters determining the radiative transfer (H2O, CO2, O3, dust, albedo, clouds) are used in explicit form. Their influence on the radiation balance can be proved by variation. Thus, the computation of the radiation balance is useful for many meteorological problems. One of these problems is the determination of the field of diabatic radiative heating in a climatic model. Those climatic models structured upon steady-state zonal averaging require the availability of radiative parameters in meridional and vertical cross sections. The cross section of the daily radiative change of temperature is presented. Author (ESA)

N76-17715 Bonn Univ. (West Germany). Inst. fuer Meteorologie.

DETERMINATION OF ZONE AND TIME AVERAGED HEATING RATE BY CONDENSATION, USING FIRST LAW [DIE BESTIMMUNG DER ZONAL UND ZEITLICH GEMITTELTEN ERWAERMUNGSRATE DURCH KONDENSATION AUS DEM 1. HAUPTSATZ]

W. Thommes *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 41-43 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The determination of meteorological transports not known from observations is presented in the case of the energy equation within the scope of climatic model averaged in time and latitude. The sum of the terms not available by means of data averaged in time and latitude consists of the release of latent heat by net condensation, the heating due to radiation, the vertical heat convergence due to microscale turbulent exchange processes and the divergence of the vertical heat transport by transient eddies. After a simple parameterization of the vertical flux of sensible heat due to microscale turbulence and the vertical transient eddies, the release of latent heat by net condensation can be computed as residual. The result of vertical integration of the condensation rate yields the mean zonal precipitation. Author (ESA)

N76-17716 Bonn Univ. (West Germany). Inst. fuer Meteorologie.

ON THE REPRESENTATION OF ATMOSPHERIC TRANSPORTS IN TERMS OF STREAM FUNCTIONS FOR A CLIMATE MODEL

Michael Hantel *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 45-50 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

A zonally and time-averaged climate model was designed. It covers the atmosphere between its upper surface and the earth's surface in vertical direction and all latitudes between south and north pole in horizontal direction. Basic equations are the six averaged conservation relations for mass, horizontal momentum, potential energy, sensible, and latent heat. If properly interpreted these have the form of the mass continuity equation. Thus the pertinent fluxes can be represented in terms of stream functions. The mass transport stream function is nearly source free; the streamlines are closed. The other property transports are not source free; their streamlines intersect the boundaries of the atmosphere. The momentum and water exchange with the earth's surface becomes visible by streamlines whose horizontal gradients at the surface correspond to the vertical momentum flux and the difference evaporation minus precipitation, respectively. The streamlines of potential heat are also in exchange with space via the radiation flux across the atmosphere's upper surface. Patterns of the stream functions based on averaged data between 10 deg S to 75 deg N are shown. They are the quantitative basis for the consistency proof of the climate model. Author (ESA)

N76-17717 Deutscher Wetterdienst, Offenbach am Main (West Germany).

HUMAN ACTIVITY AND AIR TEMPERATURE SERIES IN CENTRAL EUROPE FROM A VARIATIONAL AND TREND ANALYSIS POINT OF VIEW [MENSCHLICHE AKTIVITAET UND LUFTTEMPERATURREIHEN IN MITTELEUROPA AUS DER SICHT EINER SCHWANKUNGS- UND TRENDANALYSE]

C. D. Schoenwiese *In its* Ann. of Meteorology No. 9 1974 p 51-54 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

Estimates of anthropogen quantities like industrial production, etc. (directly anthropogen) or CO2 content of the atmosphere, etc. (indirectly anthropogen) show distinct tendencies characterized by permanent increasing rise. The analyses of a few central European series of air temperature (1781 to 1972 resp. 1965) show changing tendencies within the observed period. Variational analysis by means of power spectra and numerical band pass filtering allows determination of specified regions of some 100 km diameter characterized by very similar variations within the period range 1 to 10 years. On the other hand, this variation clearly differs from one region to another. The power spectrum estimates 1781 to 1870 confronted with 1871 to 1960 distinctly differ, but in cities as well as on mountains. Author (ESA)

N76-17718 Mainz Univ. (West Germany). Inst. fuer Meteorologie.

HEATING AND COOLING BY ATMOSPHERIC AEROSOL [ERWAERMUNG UND ABKUEHLUNG DURCH ATMOSPHAERISCHES AEROSOL]

H. Grassl *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 55-59 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The measurement of absorption by atmospheric aerosol particles during the last three years gave confidence to computed values of the radiative flux divergence in the solar and terrestrial part of the spectrum. Heating and cooling rates for different atmospheres in all climates show a strong dependence on relative humidity in both spectral intervals and an additional dependence on surface albedo in the solar part. Since the dependence on relative humidity in the solar part is opposite to the dependence in the terrestrial part of the spectrum, there is always a distinct relative humidity, where cooling balances heating. At low relative humidities heating dominates. The aerosol absorption can lead to a loss or gain of energy of the earth-atmosphere system, depending on absorption strength and surface albedo. All measurements of particle absorption allow an increase or decrease of the planetary albedo depending on the surface albedo. Author (ESA)

N76-17719 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.

TESTS TO REMOVE UNDERCOOLED FOG AT OBERPFAFFENHOFEN [VERSUCHE ZUR BESEITIGUNG UNTERKUEHLTEN NEBELS IN OBERPFAFFENHOFEN]

H. G. Mueller, M. E. Reinhardt, H. Willeke, and F. Katheder *In*

Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 61-64 refs In GERMAN (For availability see N76-17709 08-47)

Methods are discussed for abatement of undercooled fog at airports. Undercooled fog is thermodynamically unsteady so that addition of artificial fine natural ice particles results in two effects: vapor pressure reduction with resulting evaporation of the undercooled water and fog drop freezing on the ice particles. In both cases, visibility will improve. Equipment was developed for ground-based inoculation of fog with solid and liquid carbon dioxide, and some successful trials are reported. ESA

N76-17720 Bonn Univ. (West Germany). Inst. fuer Meteorologie.

CONVECTION ABOVE COOLING TOWERS [KONVEKTION UEBER KUEHLTUERMEN]

B. Rudolf and K. Fraedrich *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 65-68 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The convection above cooling towers is computed by a simple one-dimensional model based upon the equation of motion in the vertical, the first law of thermodynamics, and the continuity equation. The following assumptions are introduced: quasi-hydrostatic equilibrium, steady state conditions, and a top-hat profile. Temperature, vertical velocity, and water content of the ascending air above the cooling tower are calculated for given environmental conditions (wind, temperature, moisture). The net fluxes of sensible and latent heat and the rate of condensation are derived. The processes inside the cooling tower are computed by a separate model to obtain the boundary conditions at the base of the plume (i.e. the top of the cooling tower). The behavior of the ascending air is classified as follows: (1) No cloud generation, (2) vertically limited cloud generation, and (3) a cloud which rises to an unlimited height. Through computation it is determined which of the above classes can be expected under different environmental conditions. The results are represented by stability-moisture diagrams for a dry and a wet cooling tower of the same heat generating magnitudes. Author (ESA)

N76-17721 Norwegian Meteorological Inst., Blindern.

QUANTITATIVE ESTIMATES OF LONG RANGE TRANSPORT OF SULPHUR POLLUTANTS IN EUROPE

J. Nordoe *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 71-77 refs Sponsored jointly by Scand. Council for Appl. Res. and OECD (For availability see N76-17709 08-47)

Knowing the regional emission of sulfur and the instantaneous wind field, long range transport of sulfur pollutants can be estimated from the equation of continuity. Along this line of approach model studies have been carried out in Scandinavia during the past two years. Both Eulerian and Lagrangian integration schemes have been used, and applications are demonstrated. Experience indicates that the dry deposition rate, as well as the conversion rate of SO2 to SO4, are critical parameters. The computed concentrations are in most cases within a factor of two of the measured concentrations at representative stations. Author (ESA)

N76-17722 Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main (West Germany). Inst. fuer Meteorologie und Geophysik.

AIR POLLUTION-METEOROLOGICAL MODEL INVESTIGATIONS IN THE LOWER MAIN AREA [DIE LUFTHYGIENISCH-METEOROLOGISCHE MODELLUNTERSUCHUNG IM UNTERMAINGEBIET]

H. W. Georgii *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 79-80 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

A short survey on the type and scope of investigations in the lower Main valley is presented. These investigations are carried out in an interdisciplinary manner by different organizations. They are laid out as the first great endeavor of a regional climatic study in the Federal Republic of Germany. The results of this study will assist the state authorities in planning the further development of the region. Author (ESA)

N76-17723 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.

POSSIBILITY OF AIR POLLUTION MEASUREMENT AND DIFFERENTIATION BETWEEN WARM AND COLD AIR MASSES NEAR A CITY USING LIDAR [MOEGLICHKEIT DER MESSUNG DES VERSCHMUTZUNGSGRADES DER LUFT UND DER UNTERSCHEIDUNG VON WARM- UND KALTLUFTMASSEN IN GROSSTADTNAEHE MITTELS LIDAR]

C. Werner *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 81-83 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The possibilities of a lidar-system to measure the vertical aerosol distribution and the inversion height in different regions are reported. It is also possible to measure invisible smoke stack emission and to calculate the distribution. The detection of different air masses could be made with a modified system using Raman scattering. Author (ESA)

N76-17724 Hamburg Univ. (West Germany). Inst. fuer Meteorologie.

PROBLEMS OF NUMERICAL SHORT AND MEDIUM TERM FORECASTING [PROBLEME DER NUMERISCHEN KURZ- UND MITTELFRISTVORHERSAGE]

G. Fischer *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 85-88 refs In GERMAN (For availability see N76-17709 08-47)

Inadequacies of present numerical weather forecasting methods are discussed, and a proposal is made for improving the method. Author (ESA)

N76-17725 Deutscher Wetterdienst, Offenbach am Main (West Germany).

NUMERICAL FORECASTING CHARTS AND PRACTICAL FORECASTING. SOME ASPECTS OF THE INTERPRETATION OF NUMERICAL FORECASTING CHARTS [NUMERISCHE VORHERSAGEKARTE UND PRAKTISCHE WETTERVORHERSAGE - EINIGE ASPEKTE BEI DER INTERPRETATION VON NUMERISCHEN VORHERSAGEKARTEN]

P. Emmrich *In its* Ann. of Meteorology No. 9 1974 p 89-101 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

Numerical forecast charts belong to the widespread range of synoptic working material. Examples are shown for profitable interpretation of these numerical forecasts in an operational method considering attributes of the 6-level-prediction model of the Deutscher Wetterdienst. Author (ESA)

N76-17726 Hamburg Univ. (West Germany). Inst. fuer Meteorologie.

DEVELOPMENT OF A GLOBAL NUMERICAL CIRCULATION MODEL [UEBER DIE ENTWICKLUNG EINES GLOBALEN NUMERISCHEN ZIRKULATIONSMODELLS]

E. Roeckner *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 103-105 refs In GERMAN (For availability see N76-17709 08-47)

The concept and preliminary results of a global model under development are presented. The test calculations relate to the mathematical part of the model: grid nets and difference methods, tested with analytic initial fields in a barotropic model atmosphere with free surface as well as in a baroclinic two layer model. ESA

N76-17727 Deutscher Wetterdienst, Offenbach am Main (West Germany).

EFFECT OF MOUNTAINS ON BAROCLINIC FORECASTING [UEBER DEN EINFLUSS VON GEBIRGEN AUF BAROKLINE VORHERSAGEN]

W. Edelmann *In its* Ann. of Meteorology No. 9 1974 p 107-114 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

Avail: NTIS

Some problems in considering the dynamic effect of mountains in a baroclinic forecast model are discussed. The usual balancing of the initial fields is insufficient; however, short-periodical gravity waves can be eliminated by time averaging the first forecast hours. Steep mountains favor the development of numerical instability, which may be suppressed by an increase of the horizontal diffusion depending on the steepness of the orography. The forecasts prove to be insensible to the choice of the vertical coordinate, and to the truncation error of the geopotential gradient and the lower boundary condition. Narrow

mountains like the Alps cannot be resolved by coarse grids; hence they will scarcely have an influence on the prediction. However, by installation of the orography in the routine model of the German Weather Service, considerably better forecasts were obtained in the surroundings of the Asiatic Highland, the Rocky Mountains, and Greenland. Author (ESA)

N76-17728 Hamburg Univ. (West Germany). Inst. fuer Meteorologie.

EFFECT OF NEAR-GROUND MOMENTUM AND HEAT FLUXES ON BAROCLINIC DEVELOPMENTS [UEBER DEN EINFLUSS VON BODENNAHEN IMPULS-UND WAERMEFLUESSEN AUF BAROKLINE ENTWICKLUNGEN]

E. Heise *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 115-119 refs In GERMAN; ENGLISH summary Sponsored by Deut. Forschungsgemeinschaft (For availability see N76-17709 08-47)

A sea surface is considered as the lower boundary of a numerical model. The water temperature depends on the north to south coordinate only and is constant in time. The variable roughness length is computed from the friction velocity. The turbulent fluxes of momentum and sensible heat are parameterized by means of resistance-laws, in which the influence of baroclinicity is not yet included. The wave development is weakened remarkably due to the action of the fluxes of sensible heat which cause a rapid reduction of the zonal temperature contrasts. In the real atmosphere this effect may be compensated by the release of latent heat in the warm-sector region. Author (ESA)

N76-17729 Kiel Univ. (West Germany). Inst. fuer Meereskunde.

ENERGY BUDGET OF THE STRATOSPHERIC HEATING 1967/1968 [ENERGETIK DER STRATOSPHAERISCHEN ERWAERMUNG 1967/68]

K. Arpe *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 121-123 In GERMAN Sponsored by Deut. Forschungsgemeinschaft (For availability see N76-17709 08-47)

Calculations of the kinetic energy budget of the large turbulent motion during the period October 15, 1967, to January 31, 1968, indicate processes which affect stratospheric heating. In the period before heating, energy is transported into the stratosphere from the troposphere by the geopotential flux and stored as zonal kinetic and potential energy. The stratosphere then becomes unstable, which can be seen from the kinetic energy of turbulent motion produced during heating by baroclinic and barotropic conversions. ESA

N76-17730 Deutscher Wetterdienst, Offenbach am Main (West Germany).

ENERGY TRANSFER FROM MEAN WIND FIELD TO WATER SURFACES DURING MODERATE AND STRONG WIND [ZUM PROBLEM DES UEBERGANGS VON ENERGIE DES MITTLEREN WINDFELDES AUF WASSEROBERFLAECHEN BEI MAESSIGEM UND STARKEM WIND]

H. P. Schmitz *In its* Ann. of Meteorology No. 9 1974 p 125-127 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

Dynamic phenomena at varying water surfaces under the influence of winds are considered. Only a small part of the work exerted by the stress of the mean wind field to the surface of the water may be transferred to the average field of motion of the water because the vectors of the average velocities of wind and water usually do not coincide, especially not in their direction. The difference between the offered energy of mean motion and that part accepted by the water may be transferred into kinetic energy of the turbulent fields of air (and water). In this way the turbulent fluxes of momentum, of sensible and latent heat at water surfaces will vary with the difference vector of the average velocities. Author (ESA)

N76-17731 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie.

PROBLEMS AND METHODS OF LOCAL WEATHER FORECASTING [PROBLEME UND METHODEN DER LOKALEN WETTERVORHERSAGE]

H. Malberg *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 129-137 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The question as to whether the development of numerical weather forecasts has led to an improvement of local weather forecast is discussed. An answer can be given by regarding the results and the quality of point prognoses and their trend for a longer period. In this connection the problems of local weatherforecast become evident. Possibilities which could gradually lead to a better realization of this complicated task are demonstrated. Author (ESA)

N76-17732 Deutscher Wetterdienst, Offenbach am Main (West Germany).

ADVANTAGES AND LIMITS OF STATISTICAL FORECASTING METHODS, EXEMPLIFIED FOR BERLIN [VORTEILE UND GRENZEN STATISTISCHER VORHERSAGEMETHODEN, DARGESTELLT AM BEISPIEL BERLIN]

W. Roeder *In its* Ann. of Meteorology No. 9 1974 p 139-143 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The psychological problem in connection with subjective forecasting and the importance of persistence is discussed for statistical weather forecasting. The usefulness of different meteorological elements as predictors is shown by the example of maximum and minimum temperature forecasts and is presented in diagrams. Another example demonstrates that at present statistical methods, too, may lead to erroneous forecasts. Author (ESA)

N76-17733 Deutscher Wetterdienst, Offenbach am Main (West Germany).

ON TRANSFERRING OBJECTIVE METHODS OF FORECASTING MINIMUM TEMPERATURES

H. Kaiser *In its* Ann. of Meteorology No. 9 1974 p 145-147 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The use of established physical models for local weather forecast is discussed. Often the use of regression equations is advisable, stressing the physical interrelations apparent in the model equations. A good example of the efficiency of this procedure is the prediction of night minimum temperatures according to Saunders. A comparison of random samples of results achieved this way in England and Germany shows that objective forecast methods such as the one by Saunders may not be transferred to other areas without reservations. It is necessary to verify their accuracy by local statistical investigations with a view towards possible improvement. The result will be the optimum adaption of these forecast methods to local conditions. Author (ESA)

N76-17734 Bundesstelle fuer Umweltangelegenheiten, Berlin (West Germany).

FORECASTING WEATHER WITH POOR EXCHANGE [ZUR VORHERSAGE AUSTAUSCHARMEN WETTERS]

D. Jost *In* Deut. Wetterdienst Ann. of Meteorology No. 9 1974 p 149-151 refs In GERMAN (For availability see N76-17709 08-47)

The forecasting of weather with exchange is discussed with regard to early warning plans which envisage emission reducing measures in case of extremely high concentrations of air pollutants. Uncertainties occur for allocating meteorological parameters to the rate cases of extremely high concentrations and to the planned forecasting of their parameters. Possibilities of forecasting this weather type are discussed based on a stagnation index. ESA

N76-17735 Deutscher Wetterdienst, Offenbach am Main (West Germany).

DIFFERENCES BETWEEN THE SURFACE- AND GEOSTROPHIC WIND IN THE GERMAN BIGHT

W. Schnapauff *In its* Ann. of Meteorology No. 9 1974 p 155-161 refs In GERMAN; ENGLISH summary (For availability see N76-17709 08-47)

The geostrophic wind was calculated with the 3-hourly observations from the Borkumriff (10002), P 8 (10004), and Sengwarden (10128) stations and compared with the mean vector wind from wind observations of lightvessels Borkumriff, P 8, and Weser (10003). The result over a period of 5 years for the mean wind velocity is given in the form of a gradient wind ruler. It includes the frequency distribution of the wind force. For the individual months of the year the deviation between

surface and geostrophic wind direction angle and of the mean strength (in knots) was calculated as function of the geostrophic wind's direction and strength. The spatial and temporal extent of the sea-breeze on the southern coast of the German Bight is described as a special case of an ageostrophic wind.
Author (ESA)

N76-17736*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ANALYSIS OF THE ERRORS ASSOCIATED WITH THE DETERMINATION OF ATMOSPHERIC TEMPERATURE FROM ATMOSPHERIC PRESSURE AND DENSITY DATA
R. A. Minzner Washington Jan. 1976 41 p refs
(NASA-TN-D-8014; G-7623) Avail: NTIS HC $4.00 CSCL 04B

A graph was developed for relating delta T/T, the relative uncertainty in atmospheric temperature T, to delta p/p, the relative uncertainty in the atmospheric pressure p, for situations, when T is derived from the slope of the pressure-height profile. A similar graph relates delta T/T to delta roh/rho, the relative uncertainty in the atmospheric density rho, for those cases when T is derived from the downward integration of the density-height profile. A comparison of these two graphs shows that for equal uncertainties in the respective basic parameters, p or rho, smaller uncertainties in the derived temperatures are associated with density-height rather than with pressure-height data. The value of delta T/T is seen to depend not only upon delta p or delta rho, and to a small extent upon the value of T or the related scale height H, but also upon the inverse of delta h, the height increment between successive observations of p or rho. In the case of pressure-height data, delta T/T is dominated by 1/delta h for all values of delta h; for density-height data, delta T/T is dominated by delta rho/rho for delta h smaller than about 5 km. In the case of T derived from density-height data, this inverse relationship between delta T/T and delta h applies only for large values of delta h, that is, for delta h > 35 km. No limit exists in the fineness of usable height resolution of T which may be derived from densities, while a fine height resolution in pressure-height data leads to temperature with unacceptably large uncertainties.
Author

N76-17737*# Pennsylvania State Univ., University Park. Dept. of Meteorology.
A NUMERICAL INVESTIGATION OF SEVERE THUNDERSTORM GUST FRONTS Final Contractor Report, Jun. 1973 - Mar. 1975
Kenneth E. Mitchell Washington NASA Dec. 1975 105 p refs
(Contract NAS8-27334)
(NASA-CR-2635) Avail: NTIS HC $5.50 CSCL 04B

A numerical model was developed to simulate the evolution and structure of severe thunderstorm gust fronts. The model is a non-hydrostatic, fine resolution, cross-sectional primitive equation model. Two-dimensional horizontal and vertical equations of motion, the continuity equation, and the thermodynamic energy equation were utilized. It was shown that two dominant factors influencing gust front configuration are surface friction and the solenoidal field coincident with the front. It is suggested that solenoidal accelerations oppose the deceleration of surface friction. After a downdraft is initiated in the model, these opposing tendencies soon reach a balance and the gust front achieves a quasi-steady configuration. Thus, the experiments indicate that surface friction does not induce a cycle of front formation and collapse. In addition, the effect of evaporative cooling in producing a vigorous downdraft was parameterized by a local cooling function. Greater cooling in the downdraft results in a more intense gust front that exhibits stronger wind maximums and greater shears. The ambient air stability was shown to be an important factor influencing the depth of the cold outflow.
Author

N76-17738*# Texas A&M Univ., College Station. Center for Applied Geosciences.
STRUCTURE OF ATMOSPHERIC TURBULENCE IN THE FRICTION LAYER BELOW 500 METERS
Stephen J. Maas and James R. Scoggins Washington NASA Feb. 1976 77 p refs
(Contract NAS8-29764)
(NASA-CR-2650) Avail: NTIS HC $5.00 CSCL 04B

Measurements of wind direction and speed, vertical velocity, and temperature were made from several levels of the 444-m tower near Oklahoma City. Turbulence quantities were calculated from the covariances between observed variables over periods ranging from 5 min to 1 hr. It was found that in some cases parameters such as mean wind speed, shearing stress, and vertical heat flux could be expressed by simple equations for periods of 15 min to 1 hr. Changes in these quantities with time are related to changes in vertical motion and stability. Power spectra were calculated for sequential 15 min, 30 min, and 1 hr periods. The effects of stability, wind speed, and surface roughness on the spectra of longitudinal and lateral velocity were examined, along with the effect of height on the spectrum of vertical velocity. This region was shown to be composed of a lower region in which mechanical turbulence dominates and an upper region dominated by convective turbulence.
Author

N76-17739*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BASELINE METEOROLOGICAL SOUNDINGS FOR PARAMETRIC ENVIRONMENTAL INVESTIGATIONS AT KENNEDY SPACE CENTER AND VANDENBERG AIR FORCE BASE
Michael Susko and J. Briscoe Stephens Feb. 1976 44 p refs
(NASA-TM-X-64986) Avail: NTIS HC $4.00 CSCL 04B

Meteorological soundings representative of the atmospheric environment at the Kennedy Space Center, Florida and Vandenberg Air Force Base, California, are presented. Synthetic meteorological soundings at Kennedy Space Center, including fall, spring, and a sea breeze, and at Vandenberg Air Force Base (sea breeze with low and high level inversion and stationary upper level troughs) are shown. Soundings of frontal passages are listed. The Titan launch soundings at Kennedy Space Center present a wide range of meteorological conditions, both seasonal and time of day variations. The meteorological data input of altitude, wind speed, wind direction, temperature, and pressure may be used as meteorological inputs for the NASA/MSFC Multilayer Diffusion Model or other models to obtain quantitative estimates of effluent concentrations associated with the potential emission of major combustion products in the lower atmosphere to simulate actual launches of space vehicles. The Titan launch soundings are also of value in terms of rocket effluent measurements for analysis purposes.
Author

N76-17740*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MODELING THE URBAN BOUNDARY LAYER
R. W. Bergstrom Jan. 1976 21 p refs
(NASA-TM-X-73099; A-6347) Avail: NTIS HC $3.50 CSCL 04B

A summary and evaluation is given of the Workshop on Modeling the Urban Boundary Layer; held in Las Vegas on May 5, 1975. Edited summaries from each of the session chairpersons are also given. The sessions were: (1) formulation and solution techniques, (2) K-theory versus higher order closure, (3) surface heat and moisture balance, (4) initialization and boundary problems, (5) nocturnal boundary layer, and (6) verification of models.
Author

N76-17741*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
WIND ESTIMATES FROM CLOUD MOTIONS: PRELIMINARY RESULTS FROM PHASES 1, 2, AND 3 OF AN IN SITU AIRCRAFT VERIFICATION EXPERIMENT
A. F. Hasler, W. E. Shenk, and W. C. Skillman Nov. 1975 17 p refs Submitted for publication
(NASA-TM-X-71061; X-911-75-302) Avail: NTIS HC $3.50 CSCL 04B

Low level aircraft equipped with Inertial Navigation Systems (INS) were used to define the vertical extent and horizontal motion of a cloud and to measure the ambient wind field. A high level aircraft, also equipped with an INS, took photographs to describe the horizontal extent of the cloud field and to measure cloud motion. The aerial photographs were also used to make a positive identification in a satellite picture of the cloud observed by the low level aircraft. The experiment was conducted over the tropical oceans in the vicinity of Florida, Puerto Rico,

Panama and in the Western Gulf of Mexico. Results for tropical cumulus clouds indicate excellent agreement between the cloud motion and the wind at the cloud base. The magnitude of the vector difference between the cloud motion and the cloud base wind is less than 1.3 m/sec for 67% of the cases with track lengths of 1 hour or longer. The cirrus cloud motions agreed best with the mean wind in the cloud layer with a vector difference of about 1.6 m/sec. Author

N76-17742# World Meteorological Organization, Geneva (Switzerland).
REPORT ON THE FIELD PHASE OF THE GARP ATLANTIC TROPICAL EXPERIMENT: SCIENTIFIC PROGRAMME
J. P. Kuettner, ed. and R. F. Long, ed. Apr. 1975 538 p refs Prepared jointly with Intern. Council of Sci. Unions
(GATE-16) Avail: NTIS HC $13.00; WMO, Geneva

The scientific strategy for the GATE field experiment is described together with the weather trends encountered, the scientific aircraft program, the achievements of the central program and the five subprograms, the data management activities, and aspects of the OMEGA/VLF systems and weather forecasting procedures. For individual titles, see N76-17743 through N76-17754.

N76-17743 World Meteorological Organization, Geneva (Switzerland).
SCIENTIFIC STRATEGY
J. P. Kuettner *In its* Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 7 p (For availability see N76-17742 08-47)
Copyright.

The general principles behind the scientific strategy of GATE are outlined together with the evolution of the scientific observing program during the field phase. The ship and aircraft programs are also briefly discussed. ESA

N76-17744 National Hurricane and Experimental Meteorology Lab., Coral Gables, Fla.
A SUMMARY OF WEATHER SYSTEMS AFFECTING WESTERN AFRICA AND THE EASTERN ATLANTIC DURING GATE
R. W. Burpee and G. Dugdale (WMO) *In* WMO Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 42 p (For availability see N76-17742 08-47)
Copyright.

A summary of the important weather features of western Africa and the eastern Atlantic is presented. Some illustrative case studies are given and diagrams showing the variations in convective activity in the GATE A/B area are included. ESA

N76-17745 World Meteorological Organization, Geneva (Switzerland).
SCIENTIFIC AIRCRAFT PROGRAMME
C. J. M. Aanensen *In its* Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 48 p (For availability see N76-17742 08-47)

The use of aircraft in general during GATE is discussed with reference to the types of aircraft and instruments used. The various aircraft missions for the basic GATE mission as well as subprogram missions are described. An assessment of the GATE aircraft program in respect to the basic mission, ITC2 missions, special boundary layer missions, radiation subprogram special missions, special oceanographic missions and special synoptic scale mission is also made. ESA

N76-17746 World Meteorological Organization, Geneva (Switzerland).
CENTRAL PROGRAMME
J. P. Kuettner, D. D. Houghton, and D. E. Parker *In its* Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 25 p (For availability see N76-17742 08-47)

A summary of the objectives of the GATE central program as related to interactions, parameterization and numerical modelling is given. The apparent degree of adequacy of the GATE data for description of tropical phenomena of various scales and for the description of the basic state is discussed. The interactions between the various scales and involving the ITC2 are described together with the parameterization of moist convection and the planetary boundary layer. Tropical data sets for numerical models are also briefly considered. ESA

N76-17747 World Meteorological Organization, Geneva (Switzerland).
SYNOPTIC-SCALE SUBPROGRAMME
D. E. Parker *In its* Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 69 p refs (For availability see N76-17742 08-47)

The scientific objections of the subprogram are outlined followed by a survey of data acquisition by various platforms during the field phase. A preliminary discussion of the synoptic data quality is presented and an account of the Synoptic-scale Subprogram Data Center (SSDC) is given. An account of research carried out during the field phase, both in near-real time numerical models round the world and in preliminary studies in Dakar is included. ESA

N76-17748 Colorado State Univ., Fort Collins.
CONVECTION SUBPROGRAMME
A. K. Betts and D. R. Rodenhuis (Maryland Univ., Coll. Park) *In* WMO Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 48 p refs Sponsored by NSF (For availability see N76-17742 08-47)

The experimental objectives of the convection subprogram are outlined and field events, decisions and changes of plan affecting the program are noted. The ship, aircraft and satellite data collection observations and missions are described and a preliminary scientific analysis and assessment is made. ESA

N76-17749 Hamburg Univ. (West Germany). Inst. fuer Meteorologie.
BOUNDARY LAYER SUBPROGRAMME
H. Hoeber *In* WMO Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 50 p refs (For availability see N76-17742 08-47)

A general review of the overall performance during the GATE boundary layer subprogram is given followed by a list of the participating platforms, scientists and instrumentation. The ship and aircraft programs are discussed and the coordination between them noted. The data quality is considered and a summary of what has been achieved within the context of the subprogram is provided. ESA

N76-17750 Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
RADIATION SUBPROGRAM
Stephen K. Cox and Helmut Kraus (Goettingen Univ.) *In* WMO Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 72 p (For availability see N76-17742 08-47)

The field phase of GATE with respect to the Radiation Subprogram is reported. A summary of the subprogram scientific activity during the field phase is presented together with some preliminary data and comments. ESA

N76-17751 World Meteorological Organization, Geneva (Switzerland). **c48**
OCEANOGRAPHIC SUBPROGRAMME
S. G. H. Philander *In its* Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 81 p (For availability see N76-17742 08-47)

The departures from the original Oceanographic Subprogram plans are described and explained and the data set available for analysis is noted. The various components of the subprogram - study of largescale oceanic circulation and study of upper-layer processes - are discussed and a description is given of the data collection platforms utilized. ESA

N76-17752 World Meteorological Organization, Geneva (Switzerland).
DATA MANAGEMENT
T. C. DeLaMoriniere and D. J. Bates *In its* Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 19 p (For availability see N76-17742 08-47)

The status of the GATE data management system is presented followed by an outline of a general data processing

strategy for GATE national processing centers. The availability of GATE data to users is discussed and a description of preliminary data sets and products - microfilms and charts - is given. ESA

N76-17753 Royal Netherlands Navy, The Hague.
OMEGA/VLF
H. Reiff *In* WMO Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 30 p refs (For availability see N76-17742 08-47)

The different windfinding systems used on various GATE ships are briefly described followed by an (uncomplete) summary of major changes made to the upper air system during GATE. The development of Omega/VLF windfinding systems during the GATE phases is given. ESA

N76-17754 National Hurricane and Experimental Meteorology Lab., Coral Gables, Fla.
FORECASTING
R. W. Burpee and G. Dugdale (WMO) *In* WMO Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 17 p (For availability see N76-17742 08-47)

The requirements regarding weather forecasts needed for the efficient planning and execution of the GATE field phase are identified. The working arrangements in Dakar are outlined and the meteorological services provided are discussed. Weather forecasting techniques are also noted. ESA

N76-17755# World Meteorological Organization, Geneva (Switzerland).
REPORT ON THE FIELD PHASE OF THE GARP ATLANTIC TROPICAL EXPERIMENT: SUMMARY OF DATA COLLECTED
T. C. DeLaMoriniere and D. J. Bates Apr. 1975 231 p Prepared jointly with Intern. Council of Sci. Unions
(GATE-19) Avail: NTIS HC $8.00; WMO, Geneva

Information on the types of measurements made by each data collection platform (including ships, buoys and meteorological satellites) and land station is given and the resulting amount of data for each type of measurement from each platform and station is estimated. For individual titles, see N76-17756 through N76-17759.

N76-17756 World Meteorological Organization, Geneva (Switzerland).
SHIP DATA COLLECTION
In its Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sum. of Data Collected Apr. 1975 p 6-132 (For availability see N76-17755 08-47)

A description of GATE ship data collection is given in terms of the amounts and time/space distribution for the various measurements. A summary of the measurements made is presented, followed by the amounts of data collected given as totals by type of measurement for each operational phase and participating ship. Detailed information on upper air and radar observations is also given together with a summary of the various ship intercomparison measurements. ESA

N76-17757 World Meteorological Organization, Geneva (Switzerland).
BUOY DATA COLLECTION
In its Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sum. of Data Collected Apr. 1975 p 134-160 (For availability see N76-17755 08-47)

A summary of the instrumentation employed on each type of buoy used during GATE is given followed by diagrams and tables summarizing the location, operational periods and data collected for each individual buoy. Oceanographic buoys are dealt with separately from those having mainly meteorological instruments. ESA

N76-17758 World Meteorological Organization, Geneva (Switzerland).
SATELLITE DATA COLLECTION
In its Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sum. of Data Collected Apr. 1975 p 162-182 (For availability see N76-17755 08-47)

The satellite data collection effort for GATE is summarized for each satellite taking part. Included are ATS 3, SMS 1, Nimbus 5, Meteor 13, 16, 17, 18, ESSA 8, and NOAA 2 and 3. The various magnetic tape and photographic products expected from each satellite along with indications of the amount of data collected and the periods of collection are also given. ESA

N76-17759 World Meteorological Organization, Geneva (Switzerland).
LAND STATION DATA COLLECTION
In its Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sum. of Data Collected Apr. 1975 p 184-217 (For availability see N76-17755 08-47)

The contribution to the international GATE data-sets of the WWW, GOS and GTS is summarized. Details on the three essential parts of GATE synoptic data requirements - radiowind/radiosonde, pilot balloons and surface observations are provided. Additional statistics on radiowind/radiosonde data collection for the GATE area and on synoptic data collection for phases I, II and III are given in annexes. ESA

N76-17760# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. Meteorology Lab.
OBJECTIVE PREDICTION OF FINE SCALE VARIATIONS IN RADIATION FOG INTENSITY Air Force Surveys in Geophysics.
William R. Tahnk May 1975 37 p refs
(AF Proj. 8628)
(AD-A014774; AFCRL-TR-75-0269; AFCRL-AFSIG-311) Avail: NTIS CSCL 04/2

An examination of objective forecast techniques using sensor equivalent visibility to forecast fine scale variations in visibility was conducted with approximately two yr of radiation fog data collected in the AFCRL mesonet-work. Using stepwise screening regression and Regression Estimation of Event Probability (REEP) techniques, the results demonstrated the usefulness of a network of remote sensors around an airfield in objectively predicting short time scale fluctuations of airfield runway visibility. The REEP technique in particular generated exceedance probabilities that display positive skill relative to a conditional climatology model (Markov) of proven validity. Skill by subjective forecasters was also demonstrated using the REEP output as guidance in the generation of short-range forecasts out to one hr. The necessity for additional network stations away from the runway was demonstrated since statistical techniques utilizing runway visibility observations only, when applied to independent data, showed large negative skill relative to the Markov model in contrast to positive skill achieved using 8 network stations of varying distances out to 16 km from the runway. GRA

N76-17761# RAND Corp., Santa Monica, Calif.
SYNOPTIC PERFORMANCE CHARACTERISTICS OF THE TWO-LEVEL ATMOSPHERIC MODEL Interim Report
C. Schutz Aug. 1975 41 p refs
(Contract DAHC15-73-C-0181; ARPA Order 189-1)
(AD-A015375; R-1689-ARPA) Avail: NTIS CSCL 04/2

This analysis of the two-level atmospheric model compares daily changes during January from three experiments and five years of observed data for surface air temperatures at Columbia, Mo., and five basic characteristics in the vicinity of the Icelandic and Aleutian Lows. Strong diurnal changes were found in all simulated temperatures, but low and high diurnal ranges that would accompany specific synoptic events in nature are not well portrayed. The positions of the lows tested based on the lowest daily pressures were clumped, and in the North Atlantic were located southwest of the climatological center. Mean January pressures from these centers showed that the simulated Icelandic Low is 4.3 mb less intense, while the Aleutian Low is 1.9 mb more intense than observed. When all analyzed low pressure centers were combined, simulated speeds were slower and durations longer than observed. Finally, the simulated tracks were shown to be farther north. GRA

N76-17762# Naval Postgraduate School, Monterey, Calif.
THE COMPUTATIONAL STABILITY PROPERTIES OF THE SHUMAN PRESSURE GRADIENT AVERAGING TECHNIQUE Final Report
Arthur L. Schoenstadt and R. T. Williams Sep. 1975 27 p refs
(RR0000110)

(AD-A015317; NPS-53Zh51Wu75091) Avail: NTIS CSCL 04/2

The stability properties of the Shuman pressure gradient averaging technique are investigated with the linearized shallow water equations. In the simplest case an analytic expression is obtained for the stability region, and the maximum time step is shown to be twice the value for the leapfrog scheme. When a mean flow is added to the equations, it is shown the maximum time step must be reduced. The time averaging suggested by Robert is examined, and again leads to a shorter time step. In each case, however, the use of the Shuman averaging allows a significantly longer time step than the conventional leapfrog scheme. GRA

N76-17763# Army Electronics Command, Fort Monmouth, N.J.
ANALYSIS OF SMS/GOES FILM DATA
B. Miers, G. Blackman, D. Langer, and N. Lorimier Sep. 1975 44 p refs
(DA Proj. 1T1-62111-AH-7)
(AD-A015473; ECOM-5573) Avail: NTIS CSCL 04/2

This report presents the first attempt by the Atmospheric Science Laboratory to objectively analyze SMS/GOES image data. Since only image data were available, a manual registration technique was used whereby prominent geographic locations in the northern hemisphere were used as landmarks. Development of proper scanning parameters, validation of the grey scale on the images, and choosing of proper smoothing parameters are discussed. A limited analysis of the meteorological factors relevant to the final data is made. GRA

N76-17764# Regis Coll., Weston, Mass.
METEOROLOGICAL AND MATHEMATICAL ANALYSIS Final Report, 10 Oct. 1971 - 7 Sep. 1974
Leonarda Burke 8 Nov. 1974 100 p refs
(Contract F19628-72-C-0019; AF Proj. 8604)
(AD-A015169; AFCRL-TR-74-0558) Avail: NTIS CSCL 04/2

A wide variety of meteorological data was reduced and analyzed and the resulting techniques, programs, and procedures appear in this Final Report. The sections are as follows: Numerical Integrations; Meso-Scale Archive and Products of digitized Video Data from ESSA Satellites; Analysis of Radiosonde Field Test Data; Objective Mesoscale Visibility Techniques; Operational Procedures in Solving the Nesting Problem; Analysis of Micrometeorology Data; A Numerical Forecasting Model for Operational Use in the Tropics; Stratospheric Environmental Quality. GRA

N76-17765# Edgewood Arsenal, Aberdeen Proving Ground, Md.
A MATHEMATICAL MODEL FOR THE ATMOSPHERIC DISSEMINATION OF EVAPORATING AEROSOL CLOUDS (EVAPORATION MODEL)
Ronald O. Pennsyle Aug. 1975 85 p refs
(DA Proj. 1W7-62718-A-092)
(AD-A015542; ED-TR-74098) Avail: NTIS CSCL 04/2

A mathematical model is presented to describe the atmospheric transport and diffusion of a cloud of vapor and/or aerosol particles taking into account the simultaneous evaporation and settling of the particles. The model has been implemented in the computer program EVAP, written in FORTRAN V for the Univac 1108. This report contains complete documentation of the program, including the computer code listing. GRA

N76-17766# Pennsylvania State Univ., University Park. Dept. of Meteorology.
EFFECT OF IMPROVED ACCURACY OF AIRCRAFT RECONNAISSANCE DATA IN THE INITIALIZATION OF A TWO-DIMENSIONAL HURRICANE MODEL
Richard A. Anthes and James E. Hoke 1 Nov. 1974 49 p refs
(Contract F11623-74-C-0220)
(AD-A015370; AWS-TR-74-258) Avail: NTIS CSCL 04/2

On the basis of a limited number of experiments, it appears that a significant improvement in a two-dimensional hurricane model's behavior results when the small errors associated with the proposed AWRS system are used instead of a system with temperature and wind errors about five times those of the AWRS system. The smaller errors associated with the new AWRS system are much less damaging; and the observations appear to be accurate enough to provide reasonably useful numerical forecasts, at least with this model. The greatest effects of the dynamic initialization, both positive and negative, occur when the observations are added at the middle tropospheric level rather than the boundary layer. When the observations are added in the boundary layer alone, the model storm has not adjusted very closely to the observation after 12 hours of dynamic initialization and little difference between the two sets of observations exists after 24 hours of forecast time. In contrast, when the observations are added to the middle tropospheric layer, the observations affect much more mass of the system and the hurricane adjusts much more rapidly. In this case, there is little imbalance after 12 hours of initialization and the differences in the model prediction persist for the duration of the forecast. GRA

N76-17767# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
ANALYSIS OF AN ALL-WEATHER SYSTEM FOR WIND SOUNDING UP TO 15 km ALTITUDE
R. B. Chadwick, E. E. Gossard, and R. G. Strauch Jun. 1975 43 p refs
(COM-75-11388/6; NOAA-TR-ERL-334) Avail: NTIS HC $4.00 CSCL 04B

Foreward-scatter radio paths are analyzed as a means of remotely measuring winds to high altitudes. The propagation problem is formulated and pertinent equations are derived. A ranging technique using pseudo-noise modulation to measure the altitude of the scattering volume is described and several possible geometries and configurations are discussed. A sample design is suggested and the performance to be expected is calculated for that design. A rough estimate is given of the equipment cost for a nationwide system capable of routinely measuring winds up to 15 km. GRA

N76-17768# National Oceanic and Atmospheric Administration, Boulder, Colo. Weather Modification Program Office.
A COMPARISON OF DYNAMIC SEEDABILITY PREDICTION WITH TWO CLOUD MODELS DURING FACE-73
William R. Cotton Jun. 1975 21 p refs
(COM-75-11405/8; NOAA-TM-ERL-WMPO-22;
NOAA-75091001) Avail: NTIS HC $3.50 CSCL 04B

Seedability prediction of the EMB one-dimensional cumulus model are compared with those of the PSU 71 model for July 1973 during the Florida Area Cumulus Experiment conducted by the Experimental Meteorology Laboratory. It was found that the EMB model generally predicts a higher magnitude maximum seedability and at a larger cloud radius than does the PSU 71 model. Neither cloud model showed a clearcut superiority over the other as an aid to the decision process involved in the operation of a weather modification experiment. GRA

N76-17769# Colorado State Univ., Fort Collins.
WORKSHOP FOR AN ASSESSMENT OF THE PRESENT AND POTENTIAL ROLE OF WEATHER MODIFICATION IN AGRICULTURAL PRODUCTION
Lewis O. Grant, comp. and John D. Reid, comp. Aug. 1975 242 p refs Conf. held at Ft. Collins, Colo., 15-18 Jul. 1975 Sponsored by NSF
(PB-245633/3; AS-Paper-236) Avail: NTIS $8.00 CSCL 04B

The broad objective of the assessment of the present and future role of weather modification in agricultural production is to make an authoritative evaluation of the present and potential role that weather modification can take in increasing national and world agricultural production. A specific objective includes the preparation of an authoritative document that can receive wide distribution and provide for extensive utilization of the results of the assessment. The actual assessment is being carried out in several stages. This report is a compilation of the workshop materials. GRA

N76-17770# City Coll. of the City Univ. of New York.
SEASONAL CHANGES OF OCEANOGRAPHIC AND MARINE-CLIMATOLOGICAL CONDITIONS IN THE EQUATORIAL ATLANTIC Final Report
Gerhard Neumann, William H. Beatty, III, and Edward C. Escowitz Aug. 1975 222 p refs
(Contract N00014-72-A-0406-0007; NR Proj. 083-307)

(AD-A016290) Avail: NTIS CSCL 08/10

An attempt is made to construct more detailed monthly charts for sea surface temperature, salinity, evaporation and precipitation, based on climatological averages for 2 degrees square between 10N and 10 degrees S. This space and time resolution, at least, is required to study the complex climatological and mean oceanographic conditions, and their interrelationships, in an ocean area where significant local differences can occur at distances of a degree or two of longitude or latitude apart, and where semi-annual periodic changes may dominate the seasonal pattern. Of special interest are the relationships between sea surface salinity variations during the year and the differences between evaporation and precipitation. Special attention is given to seasonal variations of sea surface temperature anomalies, surface salinities and precipitation in the 5N to 10 degrees N latitudinal belt. This zonal belt is, essentially, dominated by the Equatorial Countercurrent. GRA

N76-17493* Kansas Univ., Lawrence.
QUANTITATIVE WATER QUALITY WITH LANDSAT AND SKYLAB
Harold Yarger and James R. McCauley *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 347-370 refs (For availability see N76-17469 08-47)
(E-9) CSCL 08H

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N76-17771*# Scientific Translation Service, Santa Barbara, Calif.
SLOPE DISTRIBUTION OF ROUGH OCEAN SURFACE
L. M. Martsinkevich Washington NASA Jan. 1976 18 p refs Transl. into ENGLISH from Meteorol. Gidrol. (USSR), no. 10, 1970 p 41-45; 50-55
(Contract NASw-2483)
(NASA-TT-F-16704) Avail: NTIS HC $3.50 CSCL 08C

Explicit expressions are obtained for the differential distribution function for the slope of the rough ocean surface for fully developed swells and for steady-state swells. An expression is also obtained for the slope distribution function, in whose analytic structure the wave elements directly observable at sea, the height and period (or steepness), appear as parameters. Other statistical characteristics of slopes are also calculated. Author

N76-17772*# Northrop Services, Inc., Huntsville, Ala.
STOCHASTIC SEA STATE FOR SRB STUDIES
M. Perlmutter and M. E. Graves Washington NASA Jan. 1976 47 p refs
(Contract NAS8-21810)
(NASA-CR-2649) Avail: NTIS HC $4.00 CSCL 08J

Ocean surface characteristics at two locations were studied for a space shuttle solid rocket booster ocean impact and recovery analysis. Probability distributions of wave heights, wave slopes, wave velocities, ocean currents, and 1-kilometer altitude winds were formulated. Procedures for generating ocean wave simulations are described. Author

N76-17773*# Linguistic Systems, Inc., Cambridge, Mass.
EMISSION FROM A DISTURBED SEA SURFACE IN THE CENTIMETER RANGE
L. M. Martsinkevich and V. V. Melentyev Washington NASA Feb. 1976 20 p refs Transl. into ENGLISH from Tr. Glav. Geofiz. Observ. (Leningrad), no. 291, 1972 p 24-33
(Contract NASw-2482)
(NASA-TT-F-16719) Avail: NTIS HC $3.50 CSCL 08J

An analytic expression is formulated for the fluxes of radio emission from a disturbed sea surface and from a real atmosphere in different wavelengths in the microwave region received by a radiometric detector located at a given altitude. Taken into account is the distribution of the slopes obtained in Martsinkevich, the choice of the basic parameters, and the elaboration of a computational scheme. Author

N76-17774*# City Coll. of the City Univ. of New York.
THE PREDICTION OF SEA-SURFACE TEMPERATURE VARIATIONS BY MEANS OF AN ADVECTIVE MIXED-LAYER OCEAN MODEL
Robert M. Atlas [1976] 109 p refs
(Grant NGR-33-013-086)
(NASA-CR-145549; Contrib-69) Avail: NTIS HC $5.50 CSCL 08C

An advective mixed layer ocean model was developed by eliminating the assumption of horizontal homogeneity in an already existing mixed layer model, and then superimposing a mean and anomalous wind driven current field. This model is based on the principle of conservation of heat and mechanical energy and utilizes a box grid for the advective part of the calculation. Three phases of experiments were conducted: evaluation of the model's ability to account for climatological sea surface temperature (SST) variations in the cooling and heating seasons, sensitivity tests in which the effect of hypothetical anomalous winds was evaluated, and a thirty-day synoptic calculation using the model. For the case studied, the accuracy of the predictions was improved by the inclusion of advection, although nonadvective effects appear to have dominated. Author

N76-17775*# City Univ. of New York.
THE THEORY AND APPLICATIONS OF OCEAN WAVE MEASURING SYSTEMS AT AND BELOW THE SEA SURFACE, ON THE LAND, FROM AIRCRAFT, AND FROM SPACECRAFT
Willard J. Pierson Jan. 1976 400 p refs
(Contract NAS5-20041)
(NASA-CR-2646) Avail: NTIS HC $10.75 CSCL 08C

Methods for measuring and analyzing ocean waves are described, including those presently in use on spacecraft and planned for SEASAT-A. Potential difficulties with synthetic aperture systems for a spacecraft are described and an alternate design is suggested. The different methods can yield different kinds of spectra and other kinds of imagery. Ways to compare different kinds of data are given. The scientific and practical applications of data from spacecraft are given. Author

N76-17776# Oregon State Univ., Corvallis. School of Oceanography.
EXPOSURE, A NEWSLETTER FOR OCEAN TECHNOLOGISTS, VOLUME 3, NUMBER 4
Roderick Nesecar Sep. 1975 14 p
(Contract N00014-67-A-0369-0007; NR Proj. 083-102)
(AD-A015327) Avail: NTIS CSCL 08/3

Contents: Improved free vehicle current meter system; Input/output communicator for the Magnavox (706) satellite navigation system; Current meter dynamic test apparatus. GRA

N76-17777# Coast Guard, Washington, D.C.
AN ANALYTICAL SEA CURRENT MODEL FOR COASTAL REGIONS WITH APPLICATION TO THE NEW YORK BIGHT
Joseph M. Bishop Sep. 1975 34 p refs
(AD-A015372; CGOU-TR-75-2) Avail: NTIS CSCL 08/3

Seasonal coastal currents on a continental shelf are modeled for use in Search and Rescue planning. The model considers a balance of Coriolis, pressure gradient, and frictional forces. Input parameters are the climatological wind and density fields. Comparison of results to currents depicted on climatological atlases for the New York Bight indicates the validity of the approach. In this light, one might extend this approach to other geographical regions where analogous oceanographic conditions prevail. GRA

N76-17778# Lehigh Univ., Bethlehem, Pa. Marine Geotechnical Lab.
RESEARCH ON THE MASS PHYSICAL AND ENGINEERING PROPERTIES OF DEEP-SEA SEDIMENTS Final Report
Adrian F. Richards 5 Sep. 1975 17 p refs
(Contract N00014-67-A-0370-0005; NR Proj. 083-248)
(AD-A016657) Avail: NTIS CSCL 08/10

This report discusses field geotechnical equipment, laboratory geotechnical equipment and procedures, and field geotechnical investigations. GRA

N76-17779# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
EXPERIMENTAL APPLICATIONS OF THE MODULAR ACOUSTIC SYSTEM FOR THE SUBMERSIBLE ALVIN Final Technical Report, 1 Feb. - 31 Aug. 1975
Paul T. McElroy Aug. 1975 108 p refs
(Contract N00014-75-C-0659; NR Proj. 260-113)
(AD-A016612; BBN-3110) Avail: NTIS CSCL 08/10

The Modular Acoustic System is a broadband general purpose acoustic measurement system designed for use on the submersible ALVIN. This report discusses four general areas for experimental research where the design features of the System, coupled with ALVIN's special capabilities, are particularly appropriate. The areas are: (1) Bottom reflectivity as a function of both frequency and angle of incidence, with particular attention to the porosity created in marine sediments by large populations of marine tube-building organisms, including polychaete worms and pogonophorans; (2) Scattering, as a function of frequency, from fish of the deep scattering layer in those special cases where only one species and one size of fish is present; (3) Measurement of the small-scale topography of the ocean bottom, and relation of that topography to scattering of energy measured as a function of frequency and angle; (4) Near-bottom seismic profiling at 3.5 kHz and higher frequencies. GRA

N76-17780# Lamont-Doherty Geological Observatory, Palisades, N.Y.
PROFILES OF TRANSPORT, CURRENT AND TEMPERATURE IN THE MODE AREAS OF THE NORTH ATLANTIC Technical Report, Sep. 1971 - Jul. 1975
T. E. Pochapsky and F. D. Malone Jul. 1975 41 p refs
(Contract N00014-67-A-0108-0011; Grant NSF GX-30987; NR Proj. 083-243)
(AD-A016291; TR-2; TR-1) Avail: NTIS CSCL 08/3

Measurements of the transport and temperature as a function of depth were obtained at two locations in the North Atlantic during the MODE experiments of the IDOE. Vertical profiles of the current as well as holographs were determined from these. Acoustic ranging was used for the flow measurements based on techniques developed in the instrumented float program on the senior author. The results of these measurements are presented in graphical form for experiments at 28 degrees N, 68.7 degrees W during a 4-day operation in 1972 and at 27.9 degrees N. 69.7 degrees W for a 11-day sequence in 1973. Profiling drops are described individually along with experimental or analytical factors affecting specific profiles. This report is a distillation of the measurements only and avoids interpretations of their significance. GRA

N76-17751 World Meteorological Organization, Geneva (Switzerland).
OCEANOGRAPHIC SUBPROGRAMME
S. G. H. Philander *In its* Rept. on the Field Phase of the GARP Atlantic Trop. Expt.: Sci. Programme Apr. 1975 81 p
(For availability see N76-17742 08-47)

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N76-17781 Wisconsin Univ., Madison.
HIGH-PRESSURE TEMPERATURE-JUMP KINETIC STUDIES OF ENZYME MODEL REACTIONS Ph.D. Thesis
Andrew Dingan Yu 1975 135 p
Avail: Univ. Microfilms Order No. 75-20800

The activation volumes of Ni(II) and Co(II) versus imidazole, alpha-and beta-aminobutyric acids were measured. The results show agreement for the energy and volume of activation with those predicted by the electrostatic theory. The sterically controlled mechanism was also found to be dissociative in nature with no apparent change in the activation parameters. Cyclodextrins have enzyme like catalytic activity because they can bind substrates in their molecular cavity. The activation volume of cyclohexaamylose with azo dyes is almost zero. With the recent crystallographic data, it is concluded that the cavity of CHA is not hydrophobic in nature. The rate determining step of the complex formation is the interaction between the substrate and the cyclodextrin ring. Dissert. Abstr.

N76-17782*# Food and Drug Administration, Cincinnati, Ohio. Food Research Lab.
ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Quarterly Progress Report, 1 Apr. - 30 Jun. 1975
A. L. Reyes and J. E. Campbell Sep. 1975 26 p refs
(NASA Order W-13411)
(NASA-CR-146401; QPR-41) Avail: NTIS HC $4.00 CSCL 06M

Spores of Bacillus subtilis var. niger were heat treated in aqueous suspension at 90 C, and observed for morphological changes and loss of viability. The 5 logs reduction that occurred in broth at 90 min required 210 min in buffered water. Five characteristic changes observed after spores were exposed 120 min at 90 C in buffered water were: (1) 90% loss of spore viability, (2) 5% stainability, (3) 76% increase in spore size (as observed by scanning electron microscopy), (4) 21% of spore areas remaining refractile, and (5) an increase of 77% in packed cell volume (PCV). Stainability and PCV changes were recognized only after secondary exposure in broth. Extended heat exposure (3 h at 90 C) resulted in 99% loss of spore viability and 99% loss of stainability. After 4 hours of heat exposure, 90% of the cells disintegrated. These results suggest that early germinal changes occurr concurrently with the early changes in the heat susceptibility of dormant spores. Author

N76-17783# Baylor Univ., Houston, Tex. Dept. of Pediatrics.
PHYSICAL CHEMICAL STATE OF WATER IN LIVING CELLS Annual Report, 1 Aug. 1974 - 31 Jul. 1975
Carlton F. Hazlewood 15 Sep. 1975 13 p refs
(Contract N00014-75-A-0017; NR Proj. 105-788)
(AD-A014929; AR-1) Avail: NTIS CSCL 06/16

The role of water in basic physiological processes is defined. A fundamental understanding of the physical chemical state of water in living cells is established. The inter-relationship between various physiological states and the physical state of water in cellular and subcellular fractions is studied. Particular emphasis is placed on defining the role of water in cellular accumulation and exclusion of ions and other solutes. GRA

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N76-17784 Florida Univ., Gainesville.
AUTOMATED ANALYSIS OF BIOLOGICAL RHYTHMS IN THE HUMAN ELECTROENCEPHALOGRAM Ph.D. Thesis
Barry Patrick Keane 1975 256 p
Avail: Univ. Microfilms Order No. 76-4245

Biological rhythms in the human electroencephalogram are analyzed by using modern hardware and software techniques. Based essentially on their frequency range, several types of EEG activity are defined, ranging from delta (.5 to 2.0 Hz) to beta (15 to 33 Hz). Several methods of detection of the above activities are discussed, including the technique used for this study, based on zero crossing and pattern detection. Results show a number of previously unknown ontogenetic patterns in the ultradian occurrences of alpha, beta, delta, sigma, and rapid eye movement (REM) activity. Dissert. Abstr.

N76-17785*+ National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 149, JANUARY 1976
Jan. 1976 73 p
(NASA-SP-7011(149)) Avail: NTIS HC $4.00 (special price) CSCL 06E

This bibliography lists 204 reports, articles, and other documents introduced into the NASA scientific and technical information system in December 1975. Author

N76-17786# Advisory Group for Aerospace Research and Development, Paris (France).

EFFECTS OF LONG DURATION NOISE EXPOSURE ON HEARING AND HEALTH

Milton A. Whitcomb, ed. (NSF) Nov. 1975 94 p refs Presented at the Aerospace Med. Panel Specialists Meeting, Toronto, 5 May 1975

(AGARD-CP-171) Avail: NTIS HC $5.00

There can be no doubt that noise exposures of durations greater than eight hours present a hazard to the hearing of air crews flying noisy aircraft and, particularly, for those more susceptible crew members. Noise reduction around NATO airports to insure public health is examined. Data are examined on the incidence of stress-induced pathologies such as ulcers or emotional disorders for those exposed to long-duration noise, as compared to nonnoise exposed individuals. Flight crews exposed to such long durations of noise were monitored both audiometrically and for abnormal incidence of cardiovascular disease, ulcers, and other psychosomatic complaints. Long-duration noise exposure to the moderate levels of noise that occur in aircraft cockpits was also studied. The fundamental mechanisms causing cochlear damage (mechanical and biological) are critically examined. For individual titles, see N76-17787 through N76-17799.

N76-17787 Ohio State Univ., Columbus. Dept. of Otolaryngology.

MODE OF COCHLEAR DAMAGE BY EXCESSIVE NOISE, AN OVERVIEW

David J. Lim and William Melnick *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 6 p refs (For availability see N76-17786 08-52)

(Contract F33615-74-C-4049)

Damage to the cochlea is examined and is believed to be caused by a physical or metabolic stress exerted on the sensory cells. Evidence to support both mechanisms is overwhelming, and is reviewed. Injury can be brought about by the chemical or metabolic alteration in the surrounding medium. Besides apparent mechanical damage inflicted on the organ of Corti by the acoustic hyperstimulation, the evidence of metabolic damage to the sensory cells is subtle. The subtle changes include: (1) proliferation and vacuolization of endoplasmic reticulum in sensory cells, (2) swelling of mitochondria in both sensory cells and afferent nerve endings, (3) morphological alteration of stereocilia, and (4) swelling and degeneration of stria vascularis. These findings imply that the high-energy-yielding enzyme systems are rendered inoperative in these cells, resulting in cell degeneration. Photomicrographs are shown. Author

N76-17788 Ohio State Univ., Columbus. Dept. of Otolaryngology.

TTS IN MAN FROM A 24-HOUR EXPOSURE TO AN OCTAVE BAND OF NOISE CENTERED AT 4 kHz

William Melnick *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 8 p refs (For availability see N76-17786 08-52)

(Contract F33615-71-C-4049)

(AMRL-TR-75-3)

Seven men were exposed to 24 hours of continuous noise in a sound field. The noise was an octave band centered at 4 kHz at two octave band levels, 80 and 85 db. Hearing thresholds were measured in one ear at 11 test frequencies ranging from 250 to 10,000 Hz prior to exposure and at selected intervals during and after exposure. Temporary threshold shift (TTS) reached asymptotic levels between 8 and 12 hours of exposure. Results indicate that maximum TTS occurs at 4 and 6 kHz. Asymptotic levels at the 80 db exposure level are 9.7 db for 4 kHz and 7.7 db for 6 kHz. With the 85 db noise level, these levels are 18.4 db and 16.5 db, respectively. Threshold shift for this subject group is less than would be expected from results of previous investigations, and is attributed to subject sampling bias. Author

N76-17789 Italian Air Force Medical Service of the 2d Air Region, Rome. Sanitary Group - 1st Aerobrigade.

PROTECTIVE EFFECTS IN MEN OF BRAIN CORTEX GANGLIOSIDES ON THE HEARING LOSS INDUCED BY HIGH LEVELS OF NOISE

G. Maniero and G. A. Molinari (Padua Univ., Italy) *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 5 p refs (For availability see N76-17786 08-52)

It is known that the prolonged exposure to noise of intensity greater than 70-80 decibels produces a temporary rise of the acoustic threshold (TTS). Gangliosides, (glycolipids which seem to interfere with the transmission of nervous impulse), were used in preventing TTS rise. By means of ganglioside administration, a possible interference on the traumatizing effect of noise on the cochlea was observed and studied. Following otologic and audiometric examination, 20 healthy male subjects were chosen. The TTS2 was calculated, both in basal conditions and after ganglioside administration. Results indicate that the gangliosides, administered in opportune doses and modalities, are capable of preventing in all subjects the physiological rise in the hearing threshold after exposure to noise. In contrast, the nontreated subjects in the same experimental conditions have either the same TTS2 or show a large shift. Therefore, the positive failure in shift, occuring in the treated patients, is most probably due to ganglioside effect. Author

N76-17790 Minnesota Univ., Minneapolis. Hearing Research Lab.

STUDIES OF ASYMPTOTIC TTS

W. Dixon Ward *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 7 p refs Sponsored by Natl. Inst. for Occupational Safety and Health (For availability see N76-17786 08-52)

Ten young normal-hearing listeners were subjected to a series of exposures to 4000-Hz noise for periods ranging from 2 to 24 hours. The asymptotic TTS (temporary threshold shift) was always reached in 8-12 hours with no suggestion of a sharp increase between 8 and 24 hours. Little difference could be seen in the rate of recovery from the TTS produced by 8- and 24-hour exposures. Results indicate that exposures longer than 8 hours are not unusually hazardous. If there is an increased risk of eventual permanent hearing damage from repeated daily exposures longer than 8 hours, it probably comes from the fact that as the daily exposure becomes longer than 8 hours, the quiet interval before the next exposure is shortened, so that the next day's exposure is begun with the auditory system still in a fatigued state. Author

N76-17791 Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

ASYMPTOTIC BEHAVIOR OF TEMPORARY THRESHOLD SHIFT DURING EXPOSURE TO LONG DURATION NOISES

D. L. Johnson, C. W. Nixon, and M. R. Stephenson *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 6 p refs (For availability see N76-17786 08-52)

Exposure to a constant noise level (pink noise, i.e., jet aircraft noise) for more than 16 hrs has been shown by many investigators to cause a Temporary Threshold Shift (TTS) in hearing that remains constant. This behavior, which is independent of exposure duration, is called Asymptotic TTS. Data are given which show that although TTS may remain constant, the recovery of hearing back to normalcy does depend on the duration of the exposure. Significant differences in recovery between a 24 hr exposure and a 48 hr exposure were observed. It is believed that for hearing conservation purposes, the time Air Force personnel should be allowed to recover from long duration noise exposures in quiet depends on the exposure duration. Suggested guidelines for assuring recovery of Asymptotic TTS are given and the research program aimed at improving these guidelines is discussed. Author

N76-17792 Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario). Behavioral Sciences Div.

THE INCIDENCE OF TEMPORARY AND PERMANENT HEARING LOSS AMONG AIRCREWS EXPOSED TO LONG-DURATION NOISE IN MARITIME PATROL AIRCRAFT

S. E. Forshaw *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 7 p refs (For availability see N76-17786 08-52)

(DCIEM-75-RP-1073)

The CP-107 Argus has been in operation with the Canadian Forces since 1957 as a long-range maritime patrol aircraft. The endurance capability of the aircraft is at least 24 hours at reconnaissance altitudes and speeds. Flight durations from 12

to 20 hours occur routinely, during which ambient noise levels at various crew and rest stations range from 90 to 99 dBA. An assessment of crew and operational problems arising from long-duration flights in the Argus shows that about half of the crew sustain temporary threshold shifts in excess of levels considered to be acceptable for long-term exposure. The hearing levels of 223 pilots, navigators and flight engineers were studied with career flying times in the Argus ranging from 2500 to 10,000 hours. Results of the study suggest that repeated long-duration noise exposure, as experienced in the aircraft, are not any more deleterious to hearing thresholds than is repeated exposure, at approximately equivalent intensity levels, in short- and medium-range aircraft. Author

N76-17793 Centro di Studi e Ricerche di Medicina Aeronautica e Spaziale, Rome (Italy).

PSYCHO-PHYSICAL PERFORMANCE OF AIR FORCE TECHNICIANS AFTER LONG DURATION NOISE EXPOSURE

Cesare A. Ramacci and Paolo Rota *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 3 p refs (For availability see N76-17786 08-52)

Psychological and psycho-physiological tests were carried out (Toulouse Pieron test, flicker fusion test, reaction time) on 20 Air Force technicians, on duty at an aircraft maintenance and flight line, exposed to high level noise. Work conditions considered were: (1) continuous exposition to noise of about 120 db, for one hour and half; and (2) continuous exposure for five hours to 60-80 db noise, with transient increases up to 90-115 db. The technicians used, when necessary, individual or collective ear protection. The technicians were divided into 3 groups and given specific tasks to perform. The tests, carried out before and after noise exposure, do not show significant changes of task performance. Author

N76-17794 Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

THE EFFECTS OF EAR PROTECTORS ON SOME AUTOMATIC RESPONSES TO AIRCRAFT AND IMPULSIVE NOISE

G. R. Froehlich *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 5 p (For availability see N76-17786 08-52)

Three different types of ear protectors were evaluated for protection against jet aircraft noise and other noise. Autonomic nervous system responses were measured for 25 subjects who participated in the study. Peripheral blood flow and electrodermal responses were also measured. Jet aircraft noise levels of 95 db, and other noises (a pistol shot) of 130 db were provided. Subjects were asked to select the ear protector giving the greatest protection. Results are presented and discussed. J.R.T.

N76-17795 Centro di Studi e Ricerche di Medicina Aeronautica e Spaziale, Rome (Italy).

INFLUENCE OF THE NOISE ON CATECHOLAMINE EXCRETION

G. Paolucci *In* AGARD Effects of Long-Duration Noise Exposure on Hearing and Health Nov. 1975 2 p (For availability see N76-17786 08-52)

Aviation specialists were exposed daily to high noises and fully protected against hearing damage by ear plugs. The exposed people were divided in two groups of ten subjects, each one exposed to different noisy conditions. One group was exposed to continuous and steady noise of 120 db for 1 hour and 1/2 hour, and the other was exposed to intermittent noise of 80-100 db for 5 hours, with intervals between impulsive bursts of 20 feet, lasting each only a few seconds. The subjective tolerance was good and no disturbance or fatigue reactions appeared at the end of the exposure. Urinary catecholamine excretion was assayed the day before the test (in noiseless place) and the next one at the end of the exposure. Results indicate that no change in catecholamine release occurs upon trained people with hearing fully protected. Author

N76-17796 Naval Regional Medical Center, San Diego, Calif. Dept. of Otolaryngology.

EFFECTS OF NOISE EXPOSURE

Robert W. Cantrell *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 13 p refs (For availability see N76-17786 08-52)

It is known that noise can damage the inner ear, result in hearing loss, be a source of annoyance, disturb sleep, and interfere with speech. There is some evidence that it may adversely affect mental health, the cardiovascular system, basic biochemistry, and decrease work performance. Current knowledge is reviewed of how intensity, duration and frequency composition of noise affects the auditory, annoyance, sleep and speech interference, psychological and sociological responses in man. Author

N76-17797 Naval Regional Medical Center, San Diego, Calif. Dept. of Otolaryngology.

PHYSIOLOGICAL EFFECTS OF NOISE

Robert W. Cantrell *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 11 p refs (For availability see N76-17786 08-52)

The effect of noise on the biochemistry of the body, the cardiovascular system, and the organ systems controlled by the autonomic nervous system are examined. Noise serves as a stressful stimulus which provokes the General Adaption Syndrome, and is one of the several stressful stimuli which activate this syndrome via the hypothalmus to the pituitary which produces ACTH resulting in increased adrenocortical activity. There is considerable evidence to support this concept, and this theory along with recently carefully controlled studies, are reviewed. Author

N76-17798 Army Aeromedical Research Lab., Fort Rucker, Ala.

AN INVESTIGATION OF AIRCRAFT VOICE COMMUNICATION SYSTEMS AS SOURCES OF INSIDIOUS LONG-TERM ACOUSTIC HAZARDS

Robert T. Camp, Jr., Ben T. Mozo, and James H. Patterson *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 6 p (For availability see N76-17786 08-52)

The acoustic output of voice communication systems was measured helicopter during training flights. The results of analyses of samples of aircraft voice communication systems noise are examined. Specifically discussed are ear protecting devices (helmets) used to reduce cockpit noise and passenger compartment noise. It is found that the microphones in the helmets emit sound levels which are harmful over a long period of time. Author

N76-17799 Universitaetsklinikum Essen (West Germany).

PHYSIOLOGICAL RESPONSES DUE TO NOISE IN INHABITANTS AROUND MUNICH AIRPORT

Gerd Jansen *In* AGARD Effects of Long Duration Noise Exposure on Hearing and Health Nov. 1975 5 p (For availability see N76-17786 08-52)

Results are examined of an interdisciplinary research study on aircraft noise effects on inhabitants around German airports. A pilot study (around Hamburg airport) and a main study (around Munich airport) were conducted by acoustical, demographic, social scientific, psychological, physiological and medical sections of scientists. It was found out that, in general, there is no adaptation to aircraft noise. A linear relation exists between increasing noise stimuli (combined noise, exposure, measure of noise levels, and number of flyovers) and human reactions. A discussion of physiological results leads to the opinion that physiological reactions are more related to sound levels whereas the 'whole reaction' (annoyance, blood pressure etc.) is more related to combined noise exposure measures. Author

N76-17800# Naval Electronic Systems Command, Washington, D.C.

NAVY SPONSORED ELF BIOLOGICAL AND ECOLOGICAL RESEARCH SUMMARY

Mar. 1975 64 p

(AD-A015299) Avail: NTIS CSCL 06/8

ELF is the Navy's extremely low frequency submarine communications system. The booklet summarizes the progress of Navy sponsored biological/ecological research studies initiated to determine the effects of electromagnetic fields in the ELF range, and lists the publications of each principal investigator. Most of the studies in this booklet were conducted at electric and/or magnetic field levels in excess of the ELF system levels

of 0.07 volt per meter and 0.2 gauss. To date, results show no significant adverse effects on humans, animals, plants, or microorganisms at electromagnetic field levels to be used for an operational ELF system. GRA

N76-17801# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
NITROGEN EXCHANGE ACROSS THE LUNGS IN RESTING MAN. FLYING PERSONNEL RESEARCH COMMITTEE
C. Davidson, P. A. Fennessy, and M. H. Harrison Feb. 1975 19 p refs
(AD-A015133; FPRC-1338) Avail: NTIS CSCL 06/16

The relationship between the partial pressure of N2 in the inspired air (PIN2), and the nitrogen transfer across the lungs (VN2), has been examined in eight resting subjects, and a study made of the effect of diet upon this relationship. Alterations in PIN2, over the range 60 mm Hg below to 20 mm Hg above ambient PIN2, caused changes in VN2 which could be described by a linear equation. These changes agreed both in magnitude and direction with those predicted by a four-compartment electrical analogue of the body N2 stores. They were not affected by the protein content of a meal taken three quarters hour before the start of measurements of VN2. The study has confirmed that N2 is metabolically inert, and indicates that the open circuit method of estimating oxygen consumption is accurate. GRA

N76-17802# Royal Air Force Inst. of Aviation Medicine, Farnborough (England). Flying Personnel Research Committee.
THE EFFECT OF EXERCISE AND THERMAL STRESS ON PLASMA VOLUME
M. H. Harrison, R. J. Edwards, and D. R. Leitch Feb. 1975 25 p refs
(AD-A015132; FPRC-1337) Avail: NTIS CSCL 06/19

Six male subjects exercised for 50 min at 25% and 55% of their estimated aerobic capacities in environments of 42C db, 35C wb, and 30C db, 24C wb respectively. Alterations in the haematocrit, haemoglobin and plasma protein concentrations, and in the activity of an injected aliquot of isotopically labelled albumin, were each used to calculate the percentage change in plasma volume occurring during exercise and recovery. It is concluded that exercise is associated with an increased translocation of protein, this leading to elevated plasma protein levels during recovery which favor the return of water to the intravascular space. Haemoglobin concentration is considered to be the most reliable measure of plasma volume change during exercise. GRA

N76-17803# Texas Univ., Austin. Bio-Medical Engineering Research Lab.
TEMPERATURE RISE IN FUNDUS EXPOSED TO LASER RADIATION Final Report, 1 May 1973 - 30 Apr. 1974
Ashley J. Welch, Clarence P. Cain, and Leslie A. Priebe Aug. 1975 79 p refs
(Contract F41609-73-C-0031; AF Proj. 6301)
(AD-A014819; SAM-TR-75-32) Avail: NTIS CSCL 06/18

Temperature measurements were made in the eyes of living rhesus monkeys with 20 micrometers copper-nickel thermocouples. The temperature rise at the center of 100 micrometers - 200 micrometers (half-power diameter) ophthalmoscopically visible lesions was used as a measurement of the threshold of damage to the eye. The appearance of a minimal visible lesion 5 minutes postexposure was the criterion for damage. Threshold temperature rise was measured for 0.1-sec, 1-sec, and 10-sec exposures to an argon (4880 A) laser. Thresholds were acquired for both macular and paramacular (temporal) exposure sites. The average macular threshold temperatures at 0.1 sec, 1 sec, and 10 sec were 29.8 C, 24.4 C, and 20.0 C respectively. For paramacular insertions the average temperature rise above ambient (37 C) was 39.0 C for a 0.1-sec exposure, 28.8 C for a 1-sec exposure, and 24.7 C for a 10-sec exposure. The temperature rise was predicted by a finite differences model solution to the heat conduction equation. The model was 10%-20% lower than the experimentally measured temperature for a 10-sec exposure and approximately 10% higher for a 0.1-sec exposure.
Author (GRA)

N76-17804# School of Aerospace Medicine, Brooks AFB, Tex.
EXAMINATION OF NORMAL AND PATHOLOGIC MIDDLE EARS BY ACOUSTIC TIME; DOMAIN REFLECTOMETRY Final Report, 1 Jan. - 31 Dec. 1973
Kent K. Gillingham Jun. 1975 39 p refs
(AD-A014818; SAM-TR-75-18; SAM-Review-2-75) Avail: NTIS CSCL 06/5

The technique of time-domain reflectometry (TDR), commonly used to locate and identify distant impedance mismatches on electrical transmission lines, was utilized in an attempt to accomplish the time-domain equivalent of acoustic impedance measurements on normal and a variety of pathologic middle ears. An acoustic transmission line and transceiver were used to deliver acoustic impulses to the middle ear through the external auditory canal and display the reflected acoustic signals on a CRO. No recognizable difference between the reflectograms of otosclerotic and normal ears was seen, and the reflections from ears with ossicular discontinuity were inconsistently different from those of normal ears. Perforated ears and ears containing fluid, however, did provide characteristic reflectograms. Several simple physical models of the external auditory canal and middle ear were tested with the acoustic reflectometer and found to provide responses similar to those from real ears. Transient responses of simple electrical analogs of normal and fluid-filled ears were generated on a computer, and waveforms similar to those seen in the corresponding acoustic reflectograms were obtained. Present short-comings and potential strengths of acoustic TDR are discussed, and several means of improving its precision are suggested. Author (GRA)

N76-17805# Naval Submarine Medical Research Lab., Groton, Conn.
THE LONGITUDINAL HEALTH STUDY, VISUAL CHARACTERISTICS OF 750 SUBMARINERS Medical Research Progress Report No. 4
Jo Ann S. Kinney, Alma P. Ryan, S. M. Luria, Helen M. Paulson, and Christine L. McKay 19 Dec. 1974 19 p refs
(AD-A014856; NSMRL-800) Avail: NTIS CSCL 06/14

A number of tests of visual health and ability are included in the ongoing Longitudinal Health Study of submariners. This paper reports on the findings to date on these visual measures for 750 submariners. The results show that the visual and ocular health of the men is good; color vision, intraocular pressures, and artery to vein ratios in the fundus are all normal. On the other hand, the men evidence poorer acuity, more myopia, a tendency toward esophoria and less accommodative ability than is expected from population statistics. GRA

N76-17806# Louisville Univ. Foundation, Inc., Ky.
HEARING CONSERVATION: INTENSE ACOUSTIC STIMULATION AND NOISE SUSCEPTIBILITY IN THE MILITARY ENVIRONMENT Final Report, 1 Oct. 1971 - 31 Mar. 1974
Michel Loeb, Bill R. Brown, Paul D. Cameron, and George A. Luz Nov. 1974 13 p refs
(Contract DADA17-72-C-2039)
(AD-A015023) Avail: NTIS CSCL 06/16

The technical objectives of this study were: (1) Assessment of current hazards to hearing and of current hearing conservation practices in the field; (2) Resolution of certain questions regarding past studies of temporary threshold shift; (3) Determination of the hearing capacities of those currently in the military or likely to be, comparison of those capacities with those of analogous groups in years past, and assessment of the practical significance of any changes observed; (4) Measurements of changes in auditory characteristics other than absolute intensive threshold, following noise exposure; and (5) Development of indices of susceptibility to permanent hearing loss. GRA

N76-17807# Defence Research Establishment Ottawa (Ontario).
THE AMOUNTS OF MOISTURE EMITTED FROM THE EYES AND PERIORBITAL AREAS
Malcolm M. Dewar and Lloyd G. Wilson Mar. 1975 21 p refs
(AD-A014923; DREO-TN-75-8) Avail: NTIS CSCL 06/16

The report presents the results of experiments carried out to determine the amount of moisture emitted by the eyes and the periorbital areas under various conditions of temperature, humidity and activity. Under ambient laboratory conditions the rate of moisture emission from the eyes varied between 0.3 and 1.5 g/h. GRA

N76-17808# Army Natick Development Center, Mass.
THE EFFECTS OF CALORIC DENSITY OF THE FOOD ON RUNNING ENDURANCE AND GENERAL CONDITION OF RATS AND HAMSTERS RESTRICTED IN FOOD INTAKE OR FED AD LIBITUM
D. Tollenaar Jun. 1975 48 p refs
(DA Proj. 1T1-61102-A-71C)
(AD-A014896; NDC-TR-75-112-FSL) Avail: NTIS CSCL 06/3

Young adult male rats and hamsters, after a treadmill training period, were divided into 6 groups, receiving 20, 40 or 70% dietary fat calories and fed ad libitum or 40% by weight of average ad libitum intake. All animals were run to exhaustion once a week. Increased dietary fat level was not correlated with superior running performance at either food intake level, although during restricted feeding the high fat groups received more calories. Increased running endurance and kgm performance were correlated with lower body weight at both food intake levels. The rate of performance increase with decreasing body weight during food restriction was significantly higher for the low than for the high fat rat group. Water consumption was considerably lower during restricted than during ad libitum feeding. Plasma glucose in the rats was lower for the 70% than for the other fat levels at both levels of food intake, lower from day 8 on during restricted than during ad libitum food intake, and lower on day 15 than on day 8 of the restricted intake. In the hamsters, average plasma triglyceride levels were 76% and plasma total cholesterol levels 22% (significant) higher in non-exercised than in regularly exercised animals right after running to exhaustion. GRA

N76-17809# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
STANDARDIZING THE DYNAMICS OF MAN
H. E. VonGierke Jun. 1975 18 p refs Repr. from Shock and Vibration Bull., Bull-45, Pt. 2 Presented at the 45th Shock and Vibration Symp., Dayton, Ohio, 22-24 Oct. 1974
(AF Proj. 7231)
(AD-A014919; AMRL-TR-74-129) Avail: NTIS CSCL 06/19

A brief review of progress in biodynamics over the past two decades has illustrated the important advances made in defining and predicting man's response to shock and vibration environments. Recent developments of standards in this area are emphasized since they indicate the practical application of the generally agreed upon results. These standards should be of interest to the designers of all transportation vehicles - water, land, air and space - and the designers of buildings as well as heavy machinery. GRA

N76-17810# State Univ. of New York, Buffalo. Dept. of Physiology.
MAN-WATER-PRESSURE. VOLUME 2: PUBLICATIONS IN UNDERWATER PHYSIOLOGY, 1967 - 1974
Edward H. Lanphier and Hermann Rahn Mar. 1975 228 p refs
(Contract N00014-71-C-0342)
(AD-A016593) Avail: NTIS CSCL 06/19

Contents: Chamber facilities; Human respiration; Submersion; Reflex responses; Cellular changes; Gas pockets; Oxygen toxicity; Exposures to pressures; Gaseous diffusion. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N76-17811# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Cologne (West Germany).
REALISTIC FLIGHT SIMULATION
1975 45 p refs In GERMAN; ENGLISH summary Proc. of the 16th Meeting of the DGLR Anthropotech. Comm., Frankfurt, 6 Nov. 1974
(DLR-Mitt-75-18) Avail: NTIS HC $4.00; DFVLR, Cologne DM 18.10

Technical and static and dynamic coupling problems of visibility simulation equipment for flight simulators are discussed. Flight simulator tests of sudden pilot incapacitation are evaluated with regard to flight safety improvement. An economic analysis of Boeing 707 simulators for crew training is presented. For individual titles, see N76-17812 through N76-17814.

N76-17812 Deutsche Lufthansa Aktiengesellschaft, Frankfurt am Main (West Germany).
SOME PROBLEMS IN THE COUPLING OF VISIBILITY SIMULATION EQUIPMENT TO FLIGHT SIMULATORS [EINIGE PROBLEME BEI DER AUFSCHALTUNG VON SICHTSIMULATIONSANLAGEN AUF FLUGSIMULATOREN] **c54**
M. Wekwerth *In* DGLR Realistic flight simulation 1975 p 7-17 In GERMAN (For availability see N76-17811 08-53)

Technical and static and dynamic coupling problems of visibility simulation equipment for flight simulators are discussed. It is clear that all software changes for adapting a simulated aircraft and a visual aid to each other lead to repercussions in the aircraft mathematical model. Deviations of certain aircraft data therefore cannot be prevented. ESA

N76-17813 Deutsche Lufthansa Aktiengesellschaft, Frankfurt am Main (West Germany).
TRAINABLE CREW BEHAVIOR IN THE FLIGHT SIMULATOR FOR PILOT INCAPACITATION [IM FLUGSIMULATOR TRAINIERBARES CREW-VERHALTEN BEI PILOT INCAPACITATION]
H. H. Renemann *In* DGLR Realistic Flight Simulation 1975 p 19-30 refs In GERMAN (For availability see N76-17811 08-53)

Flight simulator tests for sudden pilot incapacitation are evaluated with regard to flight safety, and measures for improving flight safety in these cases are discussed. ESA

N76-17814 Deutsche Lufthansa Aktiengesellschaft, Frankfurt am Main (West Germany).
THE ECONOMY OF FLIGHT SIMULATORS FOR CREW TRAINING EXEMPLIFIED FOR A BOEING 707 SIMULATOR [DIE WIRTSCHAFTLICHKEIT VON FLUGSIMULATOREN FUER DIE BESATZUNGSSCHULUNG AM BEISPIEL EINES BOEING-707-SIMULATORS]
W.-D. Hass *In* DGLR Realistic Flight Simulation 1975 p 31-39 In GERMAN (For availability see N76-17811 08-53)

An economic analysis of flight simulators for crew training is presented. Two Boeing 707 training programs are compared from the point of view of training times and costs. It is shown that a new type (of flight simulator (Redifon) is cost effective, since an accepted higher degree of reality is obtained using this simulator. ESA

N76-17815# URS/Matrix Co., Falls Church, Va.
FULLY PROCEDURALIZED JOB PERFORMANCE AIDS: GUIDANCE FOR PERFORMING BEHAVIORAL ANALYSES OF TASKS Final Report, 1 May 1971 - 3 Feb. 1975
Edgar L. Shriver Brooks AFB, Tex. AFHRL Jun. 1975 47 p refs
(Contract F33615-71-C-1638; AF Proj. 1127; AF Proj. 1710)
(AD-A015059; AFHRL-TR-75-38) Avail: NTIS CSCL 05/9

The initial tryout of the subject job aids (FPJPA), for the UH-1H helicopter, indicated that although they met all the format requirements they did not produce the expected level of task performance when used by novice and apprentice Air Force maintenance personnel. The author hypothesized that the FPJPA did not contain all the cues and directions necessary for the novice or apprentice. This report describes a method for identifying such cues and responses during a hands on tryout of the initially produced task steps, called behavioral analyses of tasks (BAT). The application of this BAT to many tasks produced an unfolding effect from pictorial to pictorial. It also identified many important but unplanned cues in the troubleshooting routines. Its application to the eleven UH-1H tasks used for the evaluation raised the performance level of both novice and apprentice personnel. GRA

N76-17816# Applied Science Associates, Inc., Reston, Va.
GUIDEBOOK FOR DEVELOPING CRITERION-REFERENCED TESTS
Robert W. Swezey and Richard B. Pearlstein Aug. 1975 187 p refs

(Contract DAHC19-74-C-0018; DA Proj. 2Q1-64715-A-757) (AD-A014987; Rept-287-AR18(2)-1R-0974) Avail: NTIS CSCL 05/10

This manual outlines the rationale for using the CRT approach and suggests specific guidelines for test developers to use in constructing test items. Methods for assessing the adequacy of a CRT are also provided. Author (GRA)

N76-17817# Air Force Human Resources Lab., Brooks AFB, Tex.

IMPACT OF COMPUTER BASED INSTRUCTION ON ATTITUDES OF STUDENTS AND INSTRUCTORS: A REVIEW Final Report

Anne Truscott King May 1975 21 p refs

(AF Proj. 1121)

(AD-A014797; AFHRL-TR-75-4) Avail: NTIS CSCL 05/10

The review examines the evidence which bears on the issue of whether contact with computer-based instruction leads to feelings of depersonalization or dehumanization. The approach is to document investigations which employ the larger construct of attitudes toward various modes of computer-based instruction which are found to be held by students and instructors before, during, or after exposure to computer-based instruction. Evaluation of pertinent factors which influence attitudes was made through an assessment of relevant literature and personal communication with experts associated with several CAI and CMI projects in the United States. GRA

N76-17818# General Electric Co., Daytona Beach, Fla.

AIRBORNE ELECTRO-OPTICAL SENSOR SIMULATION Final Report, May 1974 - Feb. 1975

M. Bunker and R. Heeschen Jul. 1975 108 p refs

(Contract F33615-74-C-5161)

(AD-A016725; AFHRL-TR-75-35) Avail: NTIS CSCL 05/9

Cost effective training of personnel in operation of infrared (IR) and low light level television (LLLTV) systems requires the development of real-time ground based equipment for simulating the performance characteristics of such systems. Such hardware must be carefully specified to provide the essential degree of validity in simulation of performances and detail of visual cues. The major effort covered in this report has been the development of an extremely versatile and unconstrained software simulation model. In such a system, increasing the complexity of scenes and of modeling computation incur no increase in cost, but are accommodated by allowing increased processing time. With essentially unconstrained scene detail capability, transfer function definition, tonal assignment capability, noise simulation characteristics, and atmospheric effects simulation, the model can readily be adjusted to simulate the characteristics of actual systems, present or future. It can further be set up to show the precise effect of simulation hardware specifications differing from actual equipment, to meet the goal of precise hardware specification. GRA

N76-17819# School of Aerospace Medicine, Brooks AFB, Tex.

NEPTUNE: MODIFICATIONS AND CURRENT APPLICATIONS Final Report, Jun. 1973 - Dec. 1974

Russell A. Benel and William F. Storm Aug. 1975 41 p refs

(AD-A016722; SAM-TR-75-20) Avail: NTIS CSCL 05/10

Recent modifications of the Neptune psychomotor test apparatus and a brief description of individual tasks are presented. Currently available system workload program listings and typical learning data under these workloads are discussed. Standardized instructions for the Neptune operator console are provided. Previous Neptune use is documented in an annotated bibliography. GRA

N76-17820# Army Aeromedical Research Lab., Fort Rucker, Ala.

OBJECT VISIBILITY PATTERNS IN LOW LEVEL FLIGHT Final Report

Robert H. Wright and J. Nicholas DeBonis Sep. 1975 38 p refs

(DA Proj. 3A7-62758-A-819)

(AD-A016886; USAARL-76-5) Avail: NTIS CSCL 06/16

Line of sight viewing angle, range and time distributions are given for a 70 kilometer sample of tree-top level annular (fisheye) imagery, and comparison made between these data and theoretical random single tree line of sight distributions. The effects of location over open and tree covered terrain are assessed, and limited data on the effect of altitude presented. Relative azimuth, elevation and range of objects when they first emerged into view were recorded by type of object. Relative angle of crossing linear features was determined, along with the duration that information of navigational value could be determined. When over trees the actual masking function was grossly different from the theoretical curves, while over open terrain actual masking approximated the five percent cover theoretical curve at close range and the one percent curve at 1000 meters. Over trees, masking for tank-size vehicles ranged from 83 to 93 percent, and over open terrain from 10 to 77 percent masking. Only 12.5 percent of linear features were found to be oriented within plus or minus 30 degrees of the nose at crossing, while 58.3 percent were within plus or minus 30 degrees of perpendicular to the nose. This finding implies that viewing to the sides as an aircraft crosses features is necessary in order to see the feature details that will provide positive geographic orientation. The detailed viewing along linear features required for positive geographic orientation was available for an average of 24 meters, or one second at 50 knots. Limited data are presented on the effect of altitude on duration of line of sight to objects that provide information of value in geographic orientation. Author (GRA)

N76-17821# Teledyne Brown Engineering, Huntsville, Ala.

EVALUATION OF GLARE REDUCTION TECHNIQUES Final Report, 14 Jun. 1974 - 20 Jun. 1975

W. L. Raine, N. E. Chatterton, and A. R. Dunn Sep. 1975 120 p refs

(Contract DOT-HS-801-718)

(PB-245624/2; DOT-HS-801-718) Avail: NTIS HC$5.50 CSCL 13F

Degradation of the visual capacity of a motor vehicle driver caused by luminous sources on the driver's own vehicle during daylight is quantified according to luminance glare theory. Effects of driver's age and daylight conditions are considered, and a means for laboratory measurement of vehicle glare production characteristics is developed. Based upon a probabalistic model of target detection, allowable glare in the field of view is determined. It is found that spot glare sources do not materially contribute to degradation of visual capacity (with the model), and that the dash of the motor vehicle is generally the largest contributor to glare. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N76-17822 Kansas State Univ., Manhattan.

DESIGN OF A PERSONAL DRY-ICE COOLING GARMENT: ITS PHYSIOLOGICAL AND HEAT TRANSFER ASPECTS Ph.D. Thesis

Jerry Richard Duncan 1975 239 p

Avail: Univ. Microfilms Order No. 76-2927

A personal dry ice cooling jacket for workers in industrial heat stress environments was developed following three stages of prototype design and evaluation. The Model-B1 cooling jacket was evaluated in two industrial environments (a tire manufacturing plant and a chemical manufacturing plant) on six workers. Modifications suggested by the industrial workers, laboratory subjects, and physiological data were incorporated into the design of Model-C. Dissert. Abstr.

N76-17823*# Pillsbury Mills, Inc., Minneapolis, Minn.

SPACE SHUTTLE FOOD SYSTEM STUDY: FOOD AND BEVERAGE PACKAGE DEVELOPMENT, MODIFICATION 8S Final Report

Jan. 1976 117 p

(Contract NAS9-13138)

(NASA-CR-147431) Avail: NTIS HC $5.50 CSCL 06K

A new, highly utile rehydration package was developed for

foods in zero gravity. Rehydratable foods will become more acceptable as a result of their overall rehydration capability and improved palatability. This new package design is greatly enhanced by the specified spacecraft condition of atmospheric pressure; the pressure differential between the atmosphere and the package carries the functional responsibility for rapid food rehydration without excess package manipulation by the consumer. Crew acceptance will further be enhanced by less manipulation, hotter rehydration water temperatures and the ability to hold the foods at preparation temperatures until they are consumed.
Author

N76-17824*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
TRADE STUDY FOR WATER AND WASTE MANAGEMENT CONCEPTS. TASK 7: SUPPORT SPECIAL ANALYSIS Final Report
Nov. 1975 113 p refs
(Contract NAS9-13404)
(NASA-CR-147432; MDC-G5853) Avail: NTIS HC $5.50 CSCL 06K

Cost analyses and tradeoff studies are given for waste management in the Space Station, Lunar Surface Bases, and interplanetary space missions. Crew drinking water requirements are discussed and various systems to recycle water are examined. The systems were evaluated for efficiency and weight savings. The systems considered effective for urine water recovery were vapor compression, flash evaporation, and air evaporation with electrolytic pretreatment. For wash water recovery, the system of multifiltration was selected. A wet oxidation system, which can process many kinds of wastes, is also considered. J.R.T.

N76-17825*# Martin Marietta Corp., Denver, Colo.
SPACECRAFT UTENSIL/HAND CLEANSING FIXTURE Final Report
Arthur A. Rosener, Thomas G. Jonkoniec, Debra A. Wilson, and Jon R. Schulz Dec. 1975 145 p
(Contract NAS9-14671)
(NASA-CR-147425; MCR-75-486) Avail: NTIS HC $6.00 CSCL 06K

A system concept for an inflight utensil/hand cleansing fixture is described which includes the following features: (1) capability for efficient cleansing and rinsing of utensils or hands, and (2) provision for general waste fluid disposal. The design concept provides for the capability of functioning for a 30 day shuttle mission containing seven occupants/users. The long range goal is to provide a functioning system capable of operating for missions of at least 120 days. The fixture is a self-contained unit that can be installed in the standard water interface requirements. Service to the unit is a single source of unheated potable water and water is discharged from the unit into a single return waste connection. In addition, the design includes provisions for the intake and discharge of purge air and the discharge of evolved gases. Both the air and the gases are filtered or processed in the assembly before releasing them into the habitability area.
Author

N76-17826*# Hamilton Standard, Windsor Locks, Conn.
FUSIBLE HEAT SINK FOR EVA THERMAL CONTROL Final Report
George J. Roebelen, Jr. Dec. 1975 112 p
(Contract NAS2-8912)
(NASA-CR-137769; SVHSER-6821) Avail: NTIS HC $5.50 CSCL 06K

The preliminary design and analysis of a heat sink system utilizing a phase change slurry material to be used eventually for astronaut cooling during manned space missions is described. During normal use, excess heat in the liquid cooling garment coolant is transferred to a reusable/regenerable fusible heat sink. Recharge is accomplished by disconnecting the heat sink from the liquid cooling garment and placing it in an on board freezer for simultaneous slurry refreeze and power supply electrical rechange.
Author

N76-17827*# Ionics, Inc., Watertown, Mass.
WATER VAPOR DIFFUSION MEMBRANE DEVELOPMENT Final Report, Feb. 1975 - Jan. 1976
Michael K. Tan Jan. 1976 71 p
(Contract NAS2-7651)
(NASA-CR-137804) Avail: NTIS HC $4.50 CSCL 06K

A total of 18 different membranes were procured, characterized, and tested in a modified bench-scale vapor diffusion water reclamation unit. Four membranes were selected for further studies involving membrane fouling. Emphasis was placed on the problem of flux decline due to membrane fouling. This is discussed in greater details under 'Summary and Discussion on Membrane Fouling Studies' presented in pages 47-51. The system was also investigated for low temperature application on wash-water where the permeated water is not recovered but vented into space vacuum.
Author

N76-17828*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
COMBINATION OF AN ELECTROLYTIC PRETREATMENT UNIT WITH SECONDARY WATER RECLAMATION PROCESSES Final Report
G. W. Wells and M. S. Bonura Sep. 1973 205 p refs
(Contract NAS1-11781)
(NASA-CR-147448; MDC-G4787) Avail: NTIS HC $7.75 CSCL 06K

The design and fabrication of a flight concept prototype electrolytic pretreatment unit (EPU) and of a contractor-furnished air evaporation unit (AEU) are described. The integrated EPU and AEU potable water recovery system is referred to as the Electrovap and is capable of processing the urine and flush water of a six-man crew. Results of a five-day performance verification test of the Electrovap system are presented and plans are included for the extended testing of the Electrovap to produce data applicable to the combination of electrolytic pretreatment with most final potable water recovery systems. Plans are also presented for a program to define the design requirements for combining the electrolytic pretreatment unit with a reverse osmosis final processing unit.
Author

N76-17829# Navy Clothing and Textile Research Unit, Natick, Mass.
VISOR SYSTEM MATERIALS FOR ALUMINIZED FIREMEN'S HOODS. REPORT 2: EVALUATION OF GOLD COATED PLASTIC SUBSTRATES
Norman F. Audet Jun. 1975 54 p refs
(AD-A015310; TR-113-Rept-2; Rept-1-75) Avail: NTIS CSCL 06/17

The Navy Clothing and Textile Research Unit became concerned with the poor durability characteristics of the gold-coated facepiece component of the crash-crew firefighter's visor system and established a program to identify the problems associated with the facepiece. Several experimental transparent plastic sample materials were obtained uncoated, gold coated, and gold coated and overcoated with different types of protective overcoatings and evaluated to determine the following: Heat transmission characteristics of the uncoated transparent plastic substrates; heat transmission characteristics of the gold coatings with and without the different types of overcoatings on the transparent plastic substrates; durability characteristics of the coated materials.
GRA

N76-17830# Systems Research Labs., Inc., Dayton, Ohio.
EVALUATION OF PHYSIOLOGICAL INPUTS TO HIGH G PERFORMANCE MODELS Final Technical Report, 15 Mar. - 30 Jun. 1974
Franklin P. Witte, Anil V. Phatak, and Jerry F. Green Wright-Patterson AFB, Ohio AMRL Jul. 1975 82 p refs
(Contract F33615-74-C-4062)
(AD-A014813; AMRL-TR-74-103) Avail: NTIS CSCL 06/19

This report presents a review of physiological model structures and recent acceleration studies that are applicable to the problem of modeling the response of the human cardiovascular system to -Gz acceleration. A recently published model of cardiovascular response is analyzed as a closed loop control system. Certain problems associated with the direct simulation of such models are identified, and methods of removing these difficulties are considered. A revised model is derived, and the results of preliminary analysis and simulation of this model are presented. A discussion of the physiological aspects of developing an improved model is included, and the next steps toward implementing this model are outlined. A brief synopsis of several

recent relevant acceleration studies concludes the report.
Author (GRA)

N76-17831# Naval Submarine Medical Research Lab., Groton, Conn.
PROCEEDING OF THE INTERNATIONAL WORKSHOP ON ESCAPE AND SURVIVAL FROM SUBMERSIBLES Final Report
Charles F. Gell and James W. Parker 15 Oct. 1974 167 p Proc. held at Groton, Conn., 20-22 Jun. 1972
(AD-A014871; NSMRL-794) Avail: NTIS CSCL 06/7

The report presents the proceedings of the International Workshop on Escape and Survival from Submersibles held at the Naval Submarine Medical Research Laboratory at the Naval Submarine Base in Groton, Connecticut USA, 20-22 June 1972. This Workshop was jointly sponsored by the U.S. Navy's Bureau of Medicine and Surgery and the Office of Naval Research. Twenty-one papers were presented, including an historical overview, a presentation of the procedures for training in the Royal Navy and the U.S. Navy, problems of prediction and treatment of decompression sickness, and outlines of escape procedures in both Navies; free-ascent techniques, and escape under saturated conditions; individual escape techniques, McCann Bell procedures and rescue via deep submergence vehicles. GRA

N76-17832# Calspan Corp., Buffalo, N.Y.
DEVELOPMENT OF AN IMPROVED COMPUTER MODEL OF THE HUMAN BODY AND EXTREMITY DYNAMICS
J. T. Fleck and F. E. Butler Jul. 1975 163 p refs
(Contract F33615-75-C-5002; AF Proj. 7231)
(AD-A014816; AMRL-TR-75-14) Avail: NTIS CSCL 06/5

Three principal modifications; namely, an improved joint formulation, an improved belt restraint formulation and inclusion of aerodynamic forces, were incorporated into the Phase III Calspan Three-Dimensional Crash Victim Model Simulation. GRA

N76-17833# Army Natick Development Center, Mass. Food Engineering Lab.
STORAGE STUDY OF INDIVIDUAL SERVINGS OF SUBSISTENCE AT VARIOUS TEMPERATURES Final Report
Marilee D. Witt and Stanley G. Wisniewski Aug. 1975 29 p refs
(AD-A014939; FEL-15; NDC-TR-75-85-FEL) Avail: NTIS CSCL 06/8

While some packaging materials appear to offer more protection to individual servings of subsistence, the results of this study indicate that the dominant factor in long-term acceptance of any product is a low storage temperature. Irrespective of the product and the method of packaging, product stored at 4.4 C (40 F) is superior to product stored at 21.1 C (70F) which, in turn, is superior to product stored at 32.2 C (90F). Author (GRA)

N76-17834# Alliance for Engineering in Medicine and Biology, Chevy Chase, Md.
A 5-YEAR RESEARCH AND DEVELOPMENT AGENDUM FOR ULTRASONIC IMAGING DIAGNOSTIC INSTRUMENTATION. AN ASSESSMENT OF SELECTED MEDICAL INSTRUMENTATION Final Report
J. H. Busser Apr. 1975 127 p refs
(Grant NSF ATA-73-03255-A03)
(PB-245680/4; Pub-N-1975-1; NSF/RA/T-75/023) Avail: NTIS HC $6.00 CSCL 06L

A priority list of research and development objectives in medical ultrasound was assembled to indicate needed development of new capabilities in diagnosis over the next five years. Detailed rationale and the complex relationships between issues are given. The four previously published, discipline-oriented reports, from which the list was developed, are included in full as appendices. Thus, a complete background of information is provided for decision making in this field. The useful life of the report is expected to extend over a 3-5 year period. GRA

N76-17812 Deutsche Lufthansa Aktiengesellschaft, Frankfurt am Main (West Germany).
SOME PROBLEMS IN THE COUPLING OF VISIBILITY SIMULATION EQUIPMENT TO FLIGHT SIMULATORS [EINIGE PROBLEME BEI DER AUFSCHALTUNG VON SICHTSIMULATIONSANLAGEN AUF FLUGSIMULATOREN]
M. Wekwerth *In* DGLR Realistic flight simulation 1975 p 7-17
In GERMAN (For availability see N76-17811 08-53)

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering.*

N76-17835 Pennsylvania Univ., Philadelphia.
DATA STORAGE DECISIONS FOR LARGE DATA BASES Ph.D. Thesis
Jay-Louise Weldon 1975 272 p
Avail: Univ. Microfilms Order No. 76-3229

A systematic methodology for making configuration decisions for large data bases is presented. For each phase of the methodology, informational and operational decision aids are provided. The primary design tool described is an interactive data base configuration model (DBCM). This model was developed to aid the data base designer in evaluating and comparing the cost and performance of alternative configurations. The methodology is illustrated by its application to the configuration of a large data base: the 1970 Census of Population and Housing.
Dissert. Abstr.

N76-17836 George Washington Univ., Washington, D.C.
MEASUREMENT AND ANALYSIS FOR COMPUTER PERFORMANCE EVALUATION Ph.D. Thesis
Clifford Allison Rose, Jr. [1975] 227 p
Avail: Univ. Microfilms Order No. 76-3785

Additional information in the area of queueing models for computer systems are provided. Specifically, a queueing network model is validated on three different computer systems, and the ranges of applicability of the model were studied. One possible use of an analytical model of a computer system is to predict the increase in performance resulting from a proposed modification of the existing system. With this aspect in mind, experiments were conducted that hypothesized situations in which a manager was considering upgrading his system and was interested in estimating the performance improvements to weigh against the anticipated costs. The basic concept was to run a benchmark program on the baseline system and to validate the model parameters. After validation, the model was used to predict CPU and I/O channel utilizations for the upgraded or reconfigured system. Lastly, the benchmark was rerun on the reconfigured system and measured utilizations were compared with predicted values from the model. Dissert. Abstr.

N76-17837*# Scientific Translation Service, Santa Barbara, Calif.
UNIVAC-1100 RING STRUCTURE PACKAGE
Washington NASA Feb. 1976 187 p Transl. into ENGLISH from "RS Kaisetsu sho" Univak/NUK p 1-168
(Contract NASw-2791)
(NASA-TT-F-16636) Avail: NTIS HC $7.50 CSCL 09B

This manual provides a summary of design specifications and explains the method of utilization of data base software ring structure package under UNIVAC-1100 series operating system. Author

N76-17838# Lockheed Missiles and Space Co., Palo Alto, Calif.
MACHINE RECOGNITION OF SECOND ORDER SURFACES
V. S. Polozov and L. F. Baginskaia [1975] 3 p Transl. into ENGLISH from Izv. VUZ Mashinostr. (USSR), no. 10, 1975 p 170-171
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The application of electron computer techniques to the recognition of three dimensional geometric objects is discussed. An algorithm for the recognition of a kind of second order surface is considered. The result of the algorithmic recognition is a print-out of equations of the second order surface and the name of the kind of surface. Author

N76-17839# Wisconsin Univ., Milwaukee. Dept. of Electrical Engineering.
THE COMPLEXITY OF CONTROL STRUCTURES AND DATA STRUCTURES Interim Report
R. A. DeMillo, R. J. Lipton, and S. C. Eisenstat Feb. 1975 31 p refs
(Grants DAHC04-74-G-0179; DAHC04-75-G-0037)
(AD-A015582; UWM-CS-RR-75-3; ARO-12142.1-EL; RR-41) Avail: NTIS CSCL 09/2

The running time or computational complexity of a sequential process is usually determined by summing weights attached to the basic operations from which the process is derived. In practice, however, the complexity is often limited by how efficiently it can access its data structures and how efficiently it can control program flow. Furthermore, it has been extensively argued that certain limitations on the process sequencing mechanisms available to the programmer result in more 'efficient' representations for the underlying processes. In this paper the authors examine these issues in an attempt to assess the 'power' of various data and control structures. GRA

N76-17840# Army Engineer Topographic Labs., Fort Belvoir, Va.
TEXTURE TONE STUDY: SUMMARY AND EVALUATION Technical Report, May 1970 - Sep. 1974
R. J. Orsinger Mar. 1975 40 p refs
(DA Proj. 4A7-52707-A-854)
(AD-A015540; ETL-0006) Avail: NTIS CSCL 09/2

This report summarizes and evaluates the work performed on the Texture Tone Study, which was a study developing a statistical model using the texture-tone information contained in digital images to extract military geographic information from the corresponding aerial images. After some introductory comments, this report describes various data sets used in the study, addresses the need for and the method of quantizing the digital images, and documents the task of selecting quantitative expressions or textural features that characterizes the various texture-tone categories in the study. In addition, a section of this report is devoted to the classification schemes used by the Contractor, to a description of a linear programming model, and to the display capability that was developed on the University of Kansas' Image Discrimination, Enhancement and Combination System (IDECS) and a PDP-15/20 computer configuration. GRA

N76-17841# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
DISTRIBUTED COMPUTATION AND TENEX-RELATED ACTIVITIES Quarterly Progress Report, 1 May - 30 Jul. 1975
J. Burchfield, R. Thomas, T. Myer, and R. Tomlinson Aug. 1975 43 p
(Contract N00014-75-C-0773; ARPA Order 2935)
(AD-A015322; BBN-3117; QPR-3) Avail: NTIS CSCL 09/2

This report describes continuing refinement of the TENEX RSEXEC distributed file system which supports geography-independent computing on a number of ARPANET TENEX sites. It also describes efforts to upgrade existing ARPANET message service to meet NAVY requirements for an interactive message processing test at CINCPAC. GRA

N76-17842# Computer Corp. of America, Cambridge, Mass.
DATA COMPUTER PROJECT Semiannual Technical Report, 1 Jan. - 30 Jun. 1975
30 Jun. 1975 67 p refs
(Contract MOA-903-74-C-0225; DARPA Order 2687)
(AD-A015125) Avail: NTIS CSCL 09/2

This report describes the work on the Datacomputer, a network data utility, from January 1, 1975 to June 30, 1975. The work is described in detail in sections 2-8. Section 2 is a discussion of the Datacomputer architecture, with emphasis on the increasing levels of functional abstraction beginning with the hardware and moving outward. Section 3 is a report on the usage of the Datacomputer during the reporting period, and a discussion of new work being done in the user services and support area. Section 4 is a detailed discussion of the work on the Datacomputer software carried out during the period under discussion. Most of the effort was concentrated in this area. Section 5 discusses the on-going work of documenting the Datacomputer. Section 6 describes progress made in the area of Datacomputer hardware and operational support. Section 7 is a bried overview of the NMRO work and its implications for the Datacomputer in general. Finally, Section 8 is a catch-all for minor but important areas of Datacomputer development. GRA

N76-17843# Federal Cobol Compiler Testing Service, Washington, D.C.
COBOL COMPILER VALIDATION SUMMARY REPORT
25 Sep. 1975 48 p Sponsored by Navy
(AD-A015189; CCVS68-VSR110) Avail: NTIS CSCL 09/2

This Validation Summary Report (VSR) provides a consolidated summary of the results obtained from the validation of the subject compiler. The VSR is made up of several sections showing the discrepancies found. These include an overview of the validation which lists all categories of discrepancies by Federal level module; a section relating the categories of discrepancies to each of the Federal levels of the language; and a detailed listing of discrepancies together with the tests which were failed. GRA

N76-17844# Northwestern Univ., Evanston, Ill. Dept. of Electrical Engineering.
FILE ORGANIZATIONS WITH CONSECUTIVE RETRIEVAL AND RELATED PROPERTIES Interim Report
Anthony N. Patrinos and S. Louis Hakimi 1975 25 p refs
(Grant AF-AFOSR-2103-71; AF Proj. 9749)
(AD-A015422; AFOSR-75-1422TR) Avail: NTIS CSCL 09/2

File organization basically involves the introduction of a structure among records (in a file) to simplify the retrieval of records with common attributes. The authors study the consecutive retrieval property in files and describe an alternative algorithm to determine whether or not a file has consecutive retrieval property. Other file structures with interesting graph theoretic properties which are generalizations of the consecutive retrieval property are introduced. Some related research problems are described. GRA

N76-17845# National Bureau of Standards, Washington, D.C.
COMPUTER SECURITY GUIDELINES FOR IMPLEMENTING THE PRIVACY ACT OF 1974 Final Report
Thomas C. Lowe May 1975 23 p refs
(COM-75-11372/0; FIPS-Pub-41) Avail: NTIS HC $3.50 CSCL 09B

Guidelines are provided for use by Federal ADP organizations in implementing the computer security safeguards necessary for compliance with Public Law 93-579, the Privacy Act of 1974. A wide variety of technical and related procedural safeguards are described. These fall into three broad categories: physical security, information management practices, and computer system/network security controls. As each organization processing personal data has unique characteristics, specific organizations should draw upon the material provided in order to select a

well-balanced combination of safeguards which meets their particular requirements. GRA

N76-17846# National Bureau of Standards, Washington, D.C. Inst. for Computer Sciences and Technology.
COMPUTER PERFORMANCE EVALUATION: REPORT OF THE 1973 NBS/ACM WORKSHOP Final Special Publication
S. Jeffery, Barry W. Boehm, and Thomas E. Bell Sep. 1975 167 p refs
(COM-75-1143819; NBS-SP-406; LC-75-619080) Avail: NTIS HC $6.75 CSCL 09B

The papers, workshop discussion, conclusions and recommendations presented in this volume address specific problems in making computer performance evaluation a commonplace and productive practice. While several of the conclusions indicate that improvements are needed in performance analysis tools, another suggests that improved application of CPE could be achieved by better documentation of analysis approaches. More integration of data collection and modeling are considered necessary for the performance analysis field to develop its full potential. Participants noted that the common emphasis on data collection or modeling, to the exclusion of considering objectives, often seriously degrades the value of performance analysis. GRA

N76-17847# National Bureau of Standards, Washington, D.C. Computer Systems Engineering Div.
CALIBRATION OF UNRECORDED LOW AND MEDIUM DENSITY TYPE MAGNETIC DISK PACK SURFACES
Nicholas P. Goumas Oct. 1975 26 p
(COM-75-11435/5; NBS-TN-884) Avail: NTIS HC $4.00 CSCL 09B

Design requirements and operation of the test bed are described to be used for calibrating unrecorded magnetic disk pack surfaces for low and medium density use. The signal level calibration is made with respect to a reference level that is derived from the NBS standard amplitude and data reference surfaces that are held in repository at NBS. The techniques for calibrating the measurement system with the repository reference surfaces and the calibration of candidate reference disks are described in detail. GRA

N76-17848# Human Engineering Labs., Aberdeen Proving Ground, Md.
A COMPARATIVE STUDY OF SINGLE-VERSUS DOUBLE-SEQUENCE DATA-ENTRY METHODS FOR USE WITH THE SB-3614/TT SWITCHBOARD Final Report
R. Bruce McCommons, Thomas C. Cook, and Monica M. Glumm Sep. 1975 25 p
(AD-A016858; HEL-TM-22-75) Avail: NTIS CSCL 09/2

Three methods of programming trunk-terminal assignments into the electrically alterable non-volatile memory (EVANVM) of the SB-3614/TT switchboard were compared. One was the double-sequence method recently proposed by the SB-3614/TT contractor (GTE Sylvania, Needham Heights, MA). The other two were single-sequence methods developed by the authors. The two single-sequence methods used identical data entry procedures; but with one, visual feedback was supplied to the test subjects (Ss) as an alphanumeric display. Results of this study showed that both single-sequence method were superior to the double-sequence method, in the Ss could program faster and made fewer errors. Of the two single-sequence methods, the one employing visual feedback enhanced Ss performance, but, overall, this enhancement was not statistically significant. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N76-17849 Rensselaer Polytechnic Inst., Troy, N.Y.
CODE EVENTS AND VARIOUS PROPERTIES OF FINITE AUTOMATA Ph.D. Thesis
Eugene K. Vedder 1975 45 p
Avail: Univ. Microfilms Order No. 76-3704

Two problems: (1) the determination of when a regular event is a code event, and (2) the determination of when a code event is noncounting and when it is locally testable are dealt with. The data serve partly to refine results of Restivo and of Hashiguchi and Honda and to prove some of the results which they state without proof. It also seeks to focus more critically on algorithms: one of the goals is to obtain algorithms for deciding properties of code events that operate on the code itself. It provides such algorithms for deciding whether or not the code event of a uniform-length code is noncounting and for deciding whether or not any unambiguous code event is locally testable. Some properties of code events and their reduced state graphs are given that enable us to determine rather quickly that many events are not code events without having to use the somewhat difficult methods given by Brzozowski. The techniques used in this research come mostly from coding theory and finite-automata theory. Dissert. Abstr.

N76-17850 Wisconsin Univ., Madison.
ON THE EQUIVALENCE AND CONTAINMENT PROBLEMS FOR REGULAR AND CONTEXT-FREE LANGUAGES Ph.D. Thesis
Jose Lucas Mourao RangelNetto 1975 101 p
Avail: Univ. Microfilms Order No. 75-23866

Several results are presented on the decidability and complexity of the equivalence and containment problems for regular and context-free languages. It is proven that the equivalence problem for regular expressions can be solved in exponential time and space. The classes E and C of the context-free languages are defined for which equivalence and containment are decidable and the closure of those two classes under several operations are proven. It is shown that the class C is an abstract family of deterministic languages, and that any generator of the family of all the context-free languages is not an element of E or C. Examples of context-free languages for which equivalence is decidable and the result that containment is decidable for all Dyck languages are included. Dissert. Abstr.

N76-17851 Ohio State Univ., Columbus.
PREFIX ENCODING WITH ARBITRARY COST CODE SYMBOLS Ph.D. Thesis
Viswanathan Santhanam 1975 252 p
Avail: Univ. Microfilms Order No. 76-3543

Efficient solution techniques for solving prefix encoding problems involving cost associated code alphabets were examined. The problems investigated include those in which the message porbabilities may be arbitrary and those in which the alphabet need not be binary. An efficient algorithm was developed for finding a most economical encoding for a set of equiprobable message using two or more code symbols of arbitrary positive costs. The complexity of this algorithm is shown to be O(n.k.log sub 2 k), where n is the number of messages and k is the size of the alphabet. The algorithm employs a set of k queues in a heap structure to store and access code word costs efficiently. For the case of nonequiprobable messages, a number of properties characterizing optimal solutions were derived. Using these properties, a selective enumeration technique was developed for the case of binary alphabets. With the purpose of finding an algorithmic alternative to this enumerative approach, a number of techniques of polynomial complexities were designed.
Dissert. Abstr.

N76-17852 Ohio State Univ., Columbus.
PARALLEL RECOGNITION OF FORMAL LANGUAGES BY CELLULAR AUTOMATA Ph.D. Thesis
Jack Michael Moshell 1975 183 p refs
Avail: Univ. Microfilms Order No. 76-3506

A class of cellular automata was investigated which accepts formal languages, in which information is transmitted through modifiable channels in a manner resembling conduction of electrical signals. A bus automaton (BA) is a cellular automaton using Mealy finite automata as cells. Each cell state has associated with it a set of binary channels linking neighbors. Paths formed from channels are busses. An input string is represented by the initial states of cells along one edge of the BA. When the 'origin cell' enters an acceptance state, the string is accepted. The set of strings accepted is the language accepted by that BA. Dissert. Abstr.

N76-17853 North Carolina State Univ., Raleigh.
A GENERALIZED APPROACH TO DIGITAL INTERFACING Ph.D. Thesis
Alice Cline Parker 1975 263 p
Avail: Univ. Microfilms Order No. 76-2419

The interface architecture is based on a set of interfacing primitives derived from proposed interface functions as well as present interfacing techniques. Basing the design on primitive allows a more direct mapping between the user program describing a specific interface and the generalized hardware. The interface designed consists of modules interconnected asynchronously by data and control buses. There are inputs and outputs to the interface for control, data, interrupt and synchronous data information. The interface can handle data asynchronously at a rate of 260 nanoseconds per word and synchronously at rates approaching 20 nanoseconds per bit, in groups of 10 or more bits. The interface is programmed in a special interfacing language which is translated by the interface control to a microprogram. This microprogram is interpreted by a fixed nanoprogram and fields from both the nano and micro instructions are output onto the control bus to communicate with the modules.
Dissert. Abstr.

N76-17854*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STANDARD CLASSIFICATION OF SOFTWARE DOCUMENTATION
R. C. Tausworthe 15 Jan. 1976 9 p refs
(Contract NAS7-100)
(NASA-CR-145932; JPL-TM-33-756) Avail: NTIS HC $3.50 CSCL 09B

General conceptual requirements for standard levels of documentation and for application of these requirements to intended usages. These standards encourage the policy to produce only those forms of documentation that are needed and adequate for the purpose. Documentation standards are defined with respect to detail and format quality. Classes A through D range, in order, from the most definitive down to the least definitive, and categories 1 through 4 range, in order, from high-quality typeset down to handwritten material. Criteria for each of the classes and categories, as well as suggested selection guidelines for each are given.
Author

N76-17855*# M&S Computing, Inc., Huntsville, Ala.
MASK ANALYSIS PROGRAM (MAP) REFERENCE MANUAL Final Report
C. L. Mitchell 21 Oct. 1975 165 p
(Contract NAS8-25621)
(NASA-CR-144042; Rept-75-0039) Avail: NTIS HC $6.75 CSCL 09B

In examining software designed specifically for artwork verification and other closely related graphic analysis functions, several major disadvantages become apparent; these are listed and discussed. The mask analysis program (MAP) was designed to avoid these pitfalls and to surpass the capability of the single function analysis programs. Two significant principles were applied in the design of MAP: MAP operates on mask data which has been converted from its original form to orthogonal rectangles with identification numbers; MAP processes are completely controlled by a unique command language. Among the mask analysis processes which the user may command are: qualitative and quantitative testing of mask areas, modification of masks, creation of masks, and computation and sorting of mask data.
Author

N76-17856*# National Aeronautics and Space Administration, Washington, D.C.
SPECIAL REPORT WRITER: A FLEXIBLE INFORMATION MANAGEMENT SYSTEM. DOCUMENTATION AND USER'S MANUAL
W. A. Greene Feb. 1976 105 p
(NASA-TM-X-3346) Avail: NTIS HC $5.50 CSCL 09B

A special report writer (SSR) was developed which performs multiple correlations on files containing several data hierarchies. Output reports are specified in a simple notation, readily learned by persons having limited familarity with ADP. The SRR system can be adopted by other NASA installations while the basic techniques themselves are compatible with the information management needs of a wide range of organizations. Specifically, the program lends itself to generalization and can be readily adapted for other file management purposes. Extensive details on the characteristics of the SRR program are presented along with a full explanation of the system for those contemplating its application to other data bases. The complete COBOL program and documentation are available.
Author

N76-17857# Texas Univ., Austin. Center for Cybernetic Studies.
A RESTRICTED DISCRETE APPROXIMATION PROBLEM IN THE (L sub 1) NORM
Ronald D. Armstrong and John W. Hultz Jul. 1975 23 p refs
(Contract N00014-75-C-0569; NR Proj. 047-021)
(AD-A015608; CCS-242) Avail: NTIS CSCL 12/2

Discrete approximation problems in the (L sub 1) norm arise in fitting by polynomials, linear regression, and goal programming. This paper presents an algorithm to solve discrete approximations in the (L sub 1) norm when the parameters are restricted by linear constraints. The algorithm is a special purpose primal linear programming method that uses certain properties of the problem to substantially reduce storage requirements and solution times. Computational experience with a computer code version of the algorithm will be presented.
GRA

N76-17858# Texas Univ., Austin. Center for Cybernetic Studies.
CONVEX PROGRAMMING AND THE LEXICOGRAPHIC MULTICRITERIA PROBLEM
A. Ben-Tal and S. Zlovec Apr. 1975 24 p refs
(Contract N00014-75-C-0569; NR Proj. 047-021)
(AD-A015611; CCS-228) Avail: NTIS CSCL 12/2

Lexicographic multicriteria problems are treated by solving successively appropriate mathematical programming problems. These mathematical programs typically lack constraint qualification. Accordingly, the classical Kuhn-Tucker optimality conditions and algorithms based on them are not applicable in this situation. However a recently developed theory of convex programming without a constraint qualification is applicable and it is used here to derive necessary and sufficient optimality conditions for convex lexicographic problems. Also a computational procedure is described.
GRA

N76-17859# Texas Univ., Austin. Center for Cybernetic Studies.
A COMPARISON OF TWO ALGORITHMS FOR ABSOLUTE DEVIATION CURVE FITTING
R. D. Armstrong and E. L. Frome Apr. 1975 18 p refs
(Contract N00014-75-C-0569; NR Proj. 047-021)
(AD-A015612; CCS-229) Avail: NTIS CSCL 12/2

A comparison is made between linear programming and weighted least squares approach to absolute deviation curve fitting. The computational results are consistent in showing linear programming substantially reduces solution times while requiring only a relatively small amount of additional storage.
GRA

N76-17860# California Univ., Berkeley. Electronics Research Lab.
A PROGRAM TO COMPUTE THE REAL SCHUR FORM OF A REAL SQUARE MATRIX Final Report
B. N. Parlett and R. Feldman Jun. 1975 32 p refs
(Contract N00014-69-A-0200-1017)
(AD-A014854; ERL-M526) Avail: NTIS CSCL 12/1

A FORTRAN program is presented which will obtain the real Schur form of a real nxn matrix in 10(n sup 3) - 30(N sup 2) multiplications (approximately).
GRA

N76-17861# California Univ., Berkeley. Electronics Research Lab.
A PROGRAM TO COMPUTE THE CONDITION NUMBERS OF MATRIX EIGENVALUE WITHOUT COMPUTING EGENVECTORS
S. P. Chan, R. Feldman, and B. N. Parlett Apr. 1975 49 p refs
(Contract N00014-69-A-0200-1017)
(AD-A014853; ERL-M517) Avail: NTIS CSCL 12/1

The condition number of an eigenvalue measures the sensitivity of that eigenvalue to small changes in the matrix

elements. Such extra information is nice, sometimes useful, but how much does it cost. A program is presented here for the most difficult case of a real square matrix whose eigenvalues are wanted without their corresponding eigenvectors. The program requires no extra storage space and the running time is about 50% longer than for the fastest reliable program which only computes eigenvalues. There are many industrial applications in which the matrix elements are known to only two or three decimal figures. Each condition number will indicate how accurately such a matrix determines the associated eigenvalue. When no digits in an eigenvalue are reliable the suspect eigenvalue should be tagged and this information passed on to a higher level in the whole computation. A number of programming devices keep, the code, storage, and running time down to a minimum. An interesting case study is included.

GRA

N76-17862# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.

SOME RELAXATION METHODS FOR LINEAR INEQUALITIES

Robert G. Teroslow Jun. 1975 22 p refs

(Contract N00014-67-A-0314-0007; Grant NSF GP-37510; NR Proj. 047-048)

(AD-A014637; RR-366) Avail: NTIS CSCL 12/1

Some relaxation methods were studied and show, that for any fixed Epsilon = 0, there is a bound on the number of arithmetic operations until a point is found satisfying all problem constraints to within Epsilon = 0. This bound is of second order in the number of variables and constraints, for problems with a fixed bound on the distance to a feasible solution (if any). Two relaxation methods are also proposed here. One of them finds an interior solution to a finite set of linear inequality constraints, if any exists. The other is designed to find approximate solutions to infinite systems of linear inequalities, and does not require that the most violated constraint be found at each iteration.

GRA

N76-17863# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.

PROGRAMS STUDENTS WRITE

Jamesine Friend 25 Jul. 1975 274 p refs

(Contract N00014-67-A-0012-0054; NR Proj. 154-326; RR04200)

(AD-A015093; TR-257) Avail: NTIS CSCL 05/9

The study addresses itself to the problem of designing an automated system for instruction in programming, and also to the study of problem-solving behavior, as exhibited by students using a CAI course in computer programming. The study uses computer programs written by 40 college students in 1972 as part of a CAI course in AID (Algebraic Interpretive Dialogue), an algebraic language similar to BASIC. The course is self-contained and consists of 50 tutorial lessons described in detail in Friend (1973). The programs analyzed were written as solutions to 25 programming problems from the course: 747 solutions containing 7063 commands were analyzed. The distribution of the data over problems and over students is discussed. Problem difficulty and diversity of student solutions are also discussed in detail.

GRA

N76-17864# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.

THE COMPUTER AS A TUTORIAL LABORATORY: THE STANFORD BIP PROJECT

Avron Barr, Marian Beard, and Richard C. Atkinson 22 Aug. 1975 74 p refs

(Contract N00014-67-A-0012-0054)

(AD-A015092; TR-260) Avail: NTIS CSCL 05/9

The BASIC Instructional Program BIP was developed to investigate tutorial modes of interaction in computer-assisted instruction (CAI). BIP is an interactive problem-solving laboratory that offers tutorial assistance to students solving introductory programming problems in the BASIC language. The problems are presented in an individualized sequence based on a representation of the structure of the curriculum and a model of the student's state of knowledge.

GRA

N76-17865# Naval Training Equipment Center, Orlando, Fla. Training Analysis and Evaluation Group.

DESIGN OF TRAINING SYSTEMS. PHASE 2A REPORT: AN EDUCATIONAL TECHNOLOGY ASSESSMENT MODEL (ETAM) Final Report

Robert E. Miller and Larry R. Duffy Jul. 1975 475 p

(AD-A015295; TAEG-12-3) Avail: NTIS CSCL 05/9

The final report outlines the study results and design for an Educational Technology Assessment Model. The primary report's feature is an eight task procedure in Section III intended to guide the assessor of a training innovation through the required data collection and analysis steps leading to a decision to accept, reject, or continue to study the innovation. Scenarios in Section V describe the step by step application of the ETAM procedures to the assessment of an innovation. A summary of conclusions and recommendations is included in the Overview, Section I. Other sections of the report include: (1) a review of relevant literature (Section II); (2) proposed portions of ETAM amenable to computerization (Section IV); and (3) validation results (Section VI).

GRA

N76-17866# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

MIXED-INITIATIVE TUTORIAL SYSTEM TO AID USERS OF THE ON-LINE SYSTEM (NLS)

Mario C. Grignetti, Laura Gould, Catherine L. Hausmann, Alan G. Bell, Gregory Harris, and Joseph Passafiume 30 Nov. 1974 134 p refs

(Contract F19628-74-C-0088; AF Proj. 2801)

(AD-A007828; ESD-TR-75-58) Avail: NTIS CSCL 05/9

NLS-SCHOLAR is a prototype system which uses artificial intelligence techniques to teach computer-naive people how to use a powerful and complex editor. It represents a computer assisted instruction (CAI) system that integrates systematic teaching with actual practice, i.e., one which can keep the user under tutorial supervision while allowing him to try out what he learns on the system he is learning about. NLS-SCHOLAR can also be used as an on-line help system outside the tutorial environment, in the course of a user's actual work. This capability of combining on-line assistance with training is an extension of the traditional notion of CAI. The techniques used in NLS-SCHOLAR are general and can be applied to the teaching of a wide variety of computer related activities.

Author (GRA)

N76-17867# Frankford Arsenal, Philadelphia, Pa.

TMDE TASK 05, INFORMATION DYNAMICS MAIDS STUDY, MICROPROGRAMMING TECHNOLOGY AND APPLICATIONS Final Report

Robert E. Dolceamore Jun. 1975 94 p refs

(DA Proj. 1G6-62610-AJ-29)

(AD-A015458; FA-TR-75006) Avail: NTIS CSCL 09/2

This report presents an initial study of the technology of microprogramming and its potential in solving the many technical problems associated with developing the MAIDS. Identified are the character and status of microprogramming and the potential arena in which microprogramming will play an important role in the future. Applications of this technology are discussed and research areas identified which are most appropriate to the technology requirements of MAIDS.

GRA

N76-17868# Massachusetts Inst. of Tech., Cambridge.

AN EXAMPLE OF PROGRAMMING WITH ABSTRACT DATA TYPES

Jack B. Dennis Sep. 1975 9 p refs Sponsored in part by ARPA

(Contract N00014-75-C-0661; Proj. MAC)

(AD-A015300; MAC-CSG-M-131) Avail: NTIS CSCL 09/2

Concepts of good program structure can and should be reflected in the design of programming languages. Thus there are two criteria for use by language designers: First, work in the area of formal proof of program correctness has shown that program proofs are greatly simplified if certain features are absent from the language in which the programs are expressed -- for example, no goto's or the absence of side effects in the execution of procedures. Second: the closeness of the language to the problem domain affects the ease with which the programmer may express a problem solution -- in particular, the data types of the language should provide a convenient match to the abstractions of the problem. A programming language should

provide tools for building abstractions that are natural for the problem at hand. GRA

N76-17869# Naval Surface Weapons Center, White Oak, Md.
A COMPARATIVE DESCRIPTION OF SEVERAL HIGH LEVEL COMPUTER LANGUAGES
C. Nicholas Pryor 9 Jul. 1975 50 p refs
(AD-A015335; NSWC/WOL/TR-75-109) Avail: NTIS CSCL 09/2

A number of high level computer languages are in current use or under development for military applications. These include FORTRAN, BASIC, ALGOL, PL/1, PL/M, CMS-2, JOVIAL, CS-4, and SPL-1. These languages are compared by comparing similar statement and declaration types in each language, and by an example program written in each of the languages. The basic facilities in each language are shown to be similar, with the differences mostly cosmetic in nature. A recommendation is made that the languages under development be derived from a common base, possibly a subset of the commercial language PL/1, to avoid unnecessary variety. GRA

N76-17870# TRW Systems Group, Dayton, Ohio.
SOFTWARE DESIGN AND VERIFICATION SYSTEM (SDVS) Interim Report, 16 Jun. 1974 - 30 Jun. 1975
W. Lynn Trainor, C. Forth, Mike Burlakoff, P. Herwegh, and W. Schraml Aug. 1975 46 p refs
(Contract F33615-74-C-1159; AF Proj. 2052)
(AD-A015176; AFAL-TR-75-31) Avail: NTIS CSCL 09/2

The software design and verification system SDVS is an integrated set of software tools designed to greatly reduce the design, development and verification efforts needed for the development of Avionics Mission Software. The Mission Software to be executed is partitioned among a number of simulated computer processors which provide bit for bit reproducibility of results which would have been obtained from the actual hardware. The software is executed on each simulated computer in either a statement level or instruction level mode depending on the level of testing or the depth of the desired hardware simulation results. The software under development is for real time applications, however, the SDVS execution is in non-real time. The feature allows testing facilities and options which are not possible in a real-time environment. GRA

N76-17871# International Business Machines Corp., Gaithersburg, Md.
STRUCTURED PROGRAMMING SERIES. VOLUME 1: PROGRAMMING LANGUAGE STANDARDS Final Technical Report
Marvin M. Kessler and Nathan Tinanoff 15 Mar. 1975 150 p refs
(Contract F30602-74-C-0186; AF Proj. 5550)
(AD-A016771; RADC-TR-74-300-Vol-1) Avail: NTIS CSCL 09/2

This report contains recommended structured programming language standards and guidelines for JOVIAL J73 and JOVIAL J73/1, JOVIAL J3, ANS FORTRAN, ANS COBOL, TACPOL and assembly languages for the S/360 and the AN/GYK-12 computers. The various language sections indicate how the recommended control logic figures may be programmed using only capabilities that are native to the languages. In addition, a more general approach to structured programming standards is described. This is based upon the development of a precompiler and suggests the use of a similar syntax for all languages. GRA

N76-17872# International Business Machines Corp., Gaithersburg, Md.
STRUCTURED PROGRAMMING SERIES. VOLUME 15: VALIDATION AND VERIFICATION STUDY Final Technical Report
Ronald L. Smith 22 May 1975 89 p refs
(Contract F30602-74-C-0186; AF Proj. 5550)
(AD-A016668; RADC-TR-74-300-Vol-15) Avail: NTIS CSCL 09/2

This volume reports on techniques currently used for verifying and validating computer programs and software systems. It also contains an analysis of the effect that structured programming technology will have on these techniques. This analysis addressed all phases of software development - definition, design, implementation, and evaluation. GRA

N76-17873# Wisconsin Univ., Madison. Mathematics Research Center.
A CHARACTERIZATION OF STABILITY IN LINEAR PROGRAMMING Summary Report
Stephen M. Robinson Jun. 1975 27 p refs
(Contract DA-31-124-ARO(D)-462; Grant NSF DCR-74-20584)
(AD-A016350; MRC-TSR-1542) Avail: NTIS CSCL 12/2

The author proves that a necessary and sufficient condition for the primal and dual solution sets of a solvable, finite-dimensional linear programming problem to be stable under small but arbitrary perturbations in the data of the problem is that both of these sets be bounded. The distance from any pair of solutions of the perturbed problem to the solution sets of the original problem is then bounded by a constant multiple of the norm of the perturbations. These results extend earlier work of Williams. GRA

N76-17874# University of South... Calif., Marina del Rey. Information Sciences Inst.
A PROCESS ELABORATION FORMALISM FOR WRITING AND ANALYZING PROGRAMS Research Report
David Wilczynski Oct. 1975 119 p refs
(Contract DAHC15-72-C-0308; ARPA Order 2223)
(AD-A016785; ISI/RR-75-35) Avail: NTIS CSCL 09/2

This research effort presents a formalism for writing programs which explicitly addresses and highlights some program construction issues. The formalism, a kind of production system, generates a graph that defines the process under inspection, making explicit both when and where variable bindings take place. From the standpoint of proper data structuring these extra dimensions are useful for analyzing a program, particularly with respect to ease of data access, access ambiguity, proper sequence of bindings, and other related issues. Because the formalism is a natural one for parsing a protocol of an instance of the process described by the productions, the system will be able to run in two modes: generation (to produce a behavior instance) or parse (determining whether a particular behavior instance could have been generated from a given program). Both these capabilities are important in debugging programs, especially those written in an Automatic Programming environment in which the system may be communicating with a nonprogrammer. GRA

N76-17875# University of Southern Calif., Marina del Rey. Information Sciences Inst.
A RESEARCH PROGRAM IN COMPUTER TECHNOLOGY Annual Report, 17 May 1974 - 30 Jun. 1975
Sep. 1975 98 p refs
(DAHC15-72-C-0308; ARPA Order 2223)
(AD-A016662; ISI/SR-75-3) Avail: NTIS CSCL 09/2

This report summarizes the research performed by USC/Information Sciences Institute from 17 May 1974 to 30 June 1975. The research is aimed at applying computer science and technology to problem areas of high DoD/military impact. The ISI program consists of eight research areas: Program Verification--logical proof of program validity; Programming Research Instrument--development of a major time-shared microprogramming facility; Automatic Programming--the study of acquiring and using problem knowledge for program generation; Protection Analysis--methods of assessing the viability of security mechanisms of operating systems; Information Automation--development of a user-oriented message service for large-scale military requirements; Network Secure Communication--work on low-bandwidth, secure voice transmission using an asynchronous packet-switched network; Special Projects--further development of Xerox Graphics Printer facilities; and ARPANET TENEX Service--operation of TENEX service and continuing development of advanced support equipment. GRA

N76-17876# Stanford Univ., Calif. Dept. of Computer Science.
PROCEDURAL UNITS AS SOFTWARE INTERRUPTS
Odd Pettersen Jun. 1975 12 p refs
(Contract DAHC15-73-C-0435; ARPA Order 2494)
(AD-A016810; SU-STAN-CS-75-501; SU-AIM-261) Avail: NTIS CSCL 09/2

The paper deals with procedural events, providing a basis for synchronization and scheduling, particularly applied on real-time program systems of multiple parallel activities (multi-task). There is a great need for convenient scheduling mechanisms for minicomputer systems as used in process control, but so far mechanisms somewhat similar to those proposed here found only in PL/1 among the generally known high-level languages. PL/1, however, is not very common on computers of this size. Also, the mechanisms in PL/1 seem more restricted, as compared to those proposed here. A new type of Boolean program variable, the EVENTMARK, is proposed. Eventmarks represent events of any kind that may occur within a computational process and are believed to give very efficient and convenient activation and scheduling of program modules in a real-time system. An eventmark is declared similar to a procedure, and the proposed feature could easily be amended as an extension to existing languages, as well as incorporated in future language designs.
Author (GRA)

N76-17877# Stanford Univ., Calif. Dept. of Computer Science.
PYGMALION: A CREATIVE PROGRAMMING ENVIRONMENT
David Canfield Smith Jun. 1975 198 p refs
(Contract DAHC15-73-C-0435; ARPA Order 2494)
(AD-A016811; SU-STAN-CS-75-499) Avail: NTIS CSCL 09/2

PYGMALION is a two-dimensional, visual programming system implemented on an interactive computer with graphics display. Communication between human being and computer is by means of visual entities called icons, subsuming the notions of variable, reference, data stucture, function and picture. The heart of the system is an interactive remembering editor for icons, which executes and (Optionally) saves operations for later reexecution. The display screen is viewed as a document to be edited. Programming consists of recreating a sequence of display frames, the last of which contains the desired information. Display frames are modified by editing operations. GRA

N76-17878# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
INTELLIGENT CAI Final Report, 1 Mar. 1971 - 31 Aug. 1975
Allan Collins and Mario C. Grignetti Oct. 1975 49 p refs
(Contract N00014-71-C-0228; ARPA Order 2284; NR Proj. 154-330)
(AD-A016613; BBN-3181; TR-6) Avail: NTIS CSCL 05/10

This paper describes the capabilities now available for building intelligent, tutorial CAI systems as exemplified by several systems including Tutor-SCHOLAR, Map-SCHOLAR, NLS-SCHOLAR and SOPHIE. The systems illustrate how a variety of sophisticated techniques can be used for tutoring different kinds of knowledge by carrying on dialogues in natural language. The systems have been developed to explore how to provide each student with his own personal, expert tutor. GRA

62 COMPUTER SYSTEMS

Includes computer networks.

N76-17879# Aerospace Corp., El Segundo, Calif.
MICROPROCESSORS AND MICROCOMPUTERS
Douglas J. Theis 16 May 1975 33 p refs
(Contract F04701-74-C-0075)
(AD-A014823; TR-0075(5112)-7; SAMSO-TR-75-206) Avail: NTIS CSCL 09/2

An overview of the latest microprocessor and microcomputer products is presented. Microprocessors are in fact the central processing unit portion of a computer on a chip. A microprocessor chip or chips together with memory chips and input-output chips qualify as a microcomputer and are available today on a single printed circuit board. The architectural features and the microelectronic technologies used to implement these devices are covered. The microprocessor survey includes 18 devices, and the microcomputer survey has 28 machines. The kinds of software needed to program them and some future trends for these products are discussed. Author (GRA)

63 CYBERNETICS

Includes feedback and control theory.
For related information see also *54 Man/System Technology and Life Support.*

N76-17880*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
A DUAL-MODE GENERALIZED LIKELIHOOD RATIO APPROACH TO SELF-REORGANIZING DIGITAL FLIGHT CONTROL SYSTEM DESIGN Research Status Report, 15 Mar. - 30 Nov. 1975
Ramon Bueno, Edward Chow, Stanley B. Gershwin, and Alan S. Willsky 30 Nov. 1975 128 p refs
(Grant NsG-1112)
(NASA-CR-146386; RR-2; ESL-IR-642) Avail: NTIS HC $6.00 CSCL 09B

The research is reported on the problems of failure detection and reliable system design for digital aircraft control systems. Failure modes, cross detection probability, wrong time detection, application of performance tools, and the GLR computer package are discussed. F.O.S.

N76-17881# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
NONLINEAR STATE ESTIMATION IN OBSERVATION NOISE OF UNKNOWN COVARIANCE
Louis L. Scharf and Daniel L. Alspach Aug. 1975 21 p refs
(Contract N00014-75-C-0518)
(AD-A015603; TR-14) Avail: NTIS CSCL 12/1

The problem of estimating the state of a stationary Gauss-Markov sequence observed in uncorrelated Gaussian noise of constant, but unknown, covariance R is considered. An inverted Wishart prior is assigned to the prior innovations covariance M, which is unknown by virtue of the uncertainty in R. The resulting nonlinear state estimator involves a canonical integral which can be approximated to yield an attractive parallel filtering structure. The structure can be used, also, to approximate the maximum a posteriori (MAP) estimate of the innovations covariance. GRA

N76-17882# Adaptronics, Inc., McLean, Va.
SEARCH TECHNIQUES FOR SELF ORGANIZING SYSTEMS Final Technical Report, 15 Aug. 1973 - 15 Oct. 1974
Elizabeth R. Johnson and Anthony N. Mucciardi Jul. 1975 84 p refs
(Contract F33615-74-C-4007; AF Proj. 7232)
(AD-A014815; AMRL-TR-75-12; Rept-682) Avail: NTIS CSCL 06/4

This study has been devoted to extension and further development of search algorithms of utility for self-organizing control systems. The four major results of this study are as follows: Self-organizing search methods developed in the previous study (AMRL-TR-73-76) have been extended to higher-dimensional multi-modal problems and have been shown to be very effective. A composite search algorithm incorporating both the pdf-guided search and the guided accelerated random search was found to be more effective than either search algorithm alone. Clustering analysis has been shown to be a valuable tool for assessing the complexity of a search surface. The number of modes (peaks), their locations relative to each other, their shape and volume, and the estimated maximum performance value within each are all adaptively determined via clustering. A new method for image encoding has been formulated that provides image reconstruction of similar quality to methods currently in use. This procedure also can find regions of possible interest within the image because of its ability to treat the image as a whole rather than line-by-line. This characteristic considerably enhances its value as a tool in image pattern recognition and classification. Author (GRA)

N76-17883# National Bureau of Standards, Washington, D.C. Optical Systems Section.
PREPARATION OF REFERENCE DATA SETS FOR CHARACTER RECOGNITION RESEARCH Final Report
M. Leighton Greenough and Robert M. McCabe 30 Jun. 1975 53 p refs Sponsored in part by the Postal Service
(COM-75-11432/2; NBSIR-75-746) Avail: NTIS HC $4.50

CSCL 09B

A reference data set contained on magnetic tape was generated for research in optical character recognition and related fields. The data set contains video data in 16 levels for each point in a 24 x 25 scanning grid, applied to approximately 30,000 characters. The input material, on some 2200 simulated address mailpieces, includes a range of character quality from excellent to poor. The data set was prepared by first microfilming the address fields and printing positive transparencies. Then preselected characters were scanned in the NBS FOSDIC. Through the use of calibrated gray scales which were filmed and scanned along with the addresses, corrections were applied to assure linearity of overall response. A second reference data set was also prepared from the same input material of simulated mailpieces. GRA

N76-17884# Stanford Univ., Calif. Dept. of Computer Science.

SYNCHRONIZATION OF CONCURRENT PROCESSES

Odd Pettersen Jul. 1975 17 p refs

(Contract DAHC15-73-C-0435; ARPA Order 2494)

(AD-A016808; SU-STAN-CS-75-502; SU-AIM-262) Avail: NTIS CSCL 09/2

The paper gives an overview of commonly used synchronization primitives and literature, and presents a new form of primitive expressing conditional critical regions. A new solution is presented to the problem of readers and writers, utilizing the proposed synchronization primitive. The solution is simpler and shorter than other known algorithms. The first sections of the paper give a tutorial introduction into established methods, in order to provide a suitable background for the remaining parts. Author (GRA)

N76-17885# Stanford Univ., Calif. Dept. of Computer Science.

THE MACRO PROCESSING SYSTEM STAGE 2: TRANSFER OF COMMENTS TO THE GENERATED TEXT

Odd Pettersen Jul. 1975 24 p

(Contract DAHC15-73-C-0435; ARPA Order 2494)

(AD-A016807; SU-STAN-CS-75-503; SU-AIM-263) Avail: NTIS CSCL 09/2

This paper is a short description of a small extension of STAGE2, providing possibilities to copy comments etc. from the source text to the generated text. The description presupposes familiarity with the STAGE2 system: its purpose, use and descriptions, like (1) to (9). Only section 3 of this paper requires knowledge of the internal structures and working of the system, and that section is unnecessary for the plain use of the described feature. The extension, if not used, is completely invisible to the user: No rules, as described in the original literature, are changed. A user, unaware of the extension, will see no difference from the original version. Author (GRA)

N76-17886# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala.

DIGITAL AUTOPILOT SAMPLE RATE SELECTION BASED ON CONTROL SYSTEM REQUIREMENTS

Edward E. Herbert 1 May 1975 12 p refs

(AD-A016874; RG-75-48) Avail: NTIS CSCL 16/4

The purpose of this paper is to discuss some considerations in the selection of a sample rate for the digital autopilot. The missile autopilot design which incorporates a digital computer or microprocessor(s) to implement the stability compensation equations requires considerations over and above those made for analog computer autopilots. Some of these considerations are: the selection of sampling frequency, the A/D converter wordlength, the phase lag contributed by the zero order data hold (i.e., the A/D converter), the transport lag in the digital computer, and the effects of sampling high frequency sensor and structural (bending) noise (foldover or aliasing).

Author (GRA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N76-17887*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.

A CLASS OF INVERSE PROBLEMS AND METHODS FOR SOLVING THEM

V. A. Morozov Washington NASA Feb. 1976 11 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 29, Jul. 1975 p 165-169

(Contract NASw-2789)

(NASA-TT-F-16892) Avail: NTIS HC $3.50 CSCL 12A

The statement of one class of inverse problems is presented including a number of thermophysical problems which demand determination of boundary or initial conditions. Some aspects of construction of regular numerical algorithms used for solving such problems are considered, and their qualitative characteristics are given. Author

N76-17888# Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.

PARTITIONING USING PAQ

Thomas D. Howell Aug. 1975 25 p refs Sponsored in part by NSF

(Contract N00014-67-A-0021)

(AD-A015089; TR-75-256) Avail: NTIS CSCL 12/1

The so-called PAQ problem is concerned with the solution of sparse systems of linear equations $Ax = b$ using the transformation $PAQy = Pb$, $x = Qy$. An algorithm is given for choosing P and Q to partition the matrix A into its irreducible components. A theorem on which this algorithm is based has long been known, yet no simple, easily understood proof appears in the literature. Such a proof is given here. Remarks are made concerning some unsolved problems related to the PAQ problem. GRA

N76-17889# Brown Univ., Providence, R.I. Div. of Applied Mathematics.

STABILITY THEORY FOR DIFFERENCE EQUATIONS

J. P. LaSalle 19 Jul. 1975 49 p refs Sponsored in part by AFOSR, Arlington, Va.

(Contract N00014-67-A-0191-0009)

(AD-A015377) Avail: NTIS CSCL 12/1

This article is designed to give through the study of difference equation (discrete dynamical systems) a view of and an introduction to the general theory of the stability of dynamical systems in its most modern aspect. Much of what is presented here is known, although not perhaps as well known as it should be, and there are some things that are new. One of these has to do with a connectedness property of the positive limit sets of the solutions of difference equations which provides a means through the use of Liapunov functions of establishing the existence of equilibrium points (fixed points) and oscillations (periodic points). Another is the generalization of the usual concept of a vector Liapunov function, and this leads to a possible method of designing control systems where the measure of the error or the performance criterion is a vector rather than a scalar. Applications of the theory are illustrated by simple examples. GRA

N76-17890# New Mexico State Univ., University Park. Engineering Experiment Station.

RECURSIVE AND MOVING CUBIC SPLINE INTERPOLATION METHODS Final Report, 14 Jan. 1974 - 13 Jan. 1975

Lonnie C. Ludeman 1 Mar. 1975 13 p refs

(Contract DAHC04-74-G-0084)

(AD-A014949; ARO-11422.3-A) Avail: NTIS CSCL 12/1

This report presents the analysis for algorithms to compute the recursive and moving spline approximations passing through a given set of values for uniformly spaced absicissa. A computer program for the recursive calculation is also given. Author (GRA)

N76-17891# Control Analysis Corp., Palo Alto, Calif.

TECHNIQUES OF RESPONSE SURFACE ESTIMATION, WITH APPLICATIONS IN COMPUTER SIMULATION

Michael A. Crane Aug. 1975 22 p refs

(Contract N00014-72-C-0086; NR Proj. 047-106)

(AD-A014917; TR-86-19) Avail: NTIS CSCL 12/1

A technique is presented for obtaining confidence intervals

and confidence bands for a one-dimensional response surface which is assumed to be a general-order polynomial. GRA

N76-17892# Naval Research Lab., Washington, D.C.
ENTIRE SOLUTIONS OF THE FUNCTIONAL EQUATION FROM PERSUC-YEVICK AND GELFAND-LEVITAN INTEGRAL EQUATIONS Interim Report
Saeyoung Ahn, Fred Gross, Charles Osgood, and Chung-Chun Yang 10 Sep. 1975 16 p refs
(AD-A015304; NRL-7911) Avail: NTIS CSCL 12/1

In this report, the authors present and discuss the most general entire-function solutions to the functional equations of the form (psi squared)(z) + rho(rho(z)rho square (z) = q(z), where z is a complex variable and rho(z) and q(z) are given polynomials. These equations are derived, from integral equations such as the Percus-Yevick and Gel'Fand-Levitan integral equations. The method is based on the theory of functions of one complex variable. GRA

N76-17893# Brown Univ., Providence, R.I. Lefschetz Center for Dynamic Systems.
ON THE ASYMPTOTIC STABILITY OF OSCILLATORS WITH UNBOUNDED DAMPING
Zvi Artstein and E. F. Infante 30 Jul. 1975 14 p refs
(Contract N00014-76-C-0278; Grant NSF GP-28931; NR Proj. 041-397)
(AD-A015463) Avail: NTIS CSCL 12/1

Through a technique inspired by the invariance principle of LaSalle, a general growth condition on the damping coefficient h(t) is given, which is sufficient for the global asymptotic stability of the origin, yet permits this coefficient to grow to infinity with time. The methods used do not depend on linearity and are applied to obtain similar results to the nonlinear analog of this equation. Author (GRA)

N76-17894# Naval Research Lab., Washington, D.C.
FAST CONVOLUTION BY NUMBER THEORETIC TRANSFORMS Interim Report
Lawrence M. Leibowitz 12 Sep. 1975 23 p refs
(AD-A015276; NRL-7924) Avail: NTIS CSCL 09/4

The concepts involved in the efficient computation of discrete convolution by number theoretic techniques were reviewed using key portions of the applicable technical literature. First, discrete convolution and its computation by direct and fast Fourier transform (FFT) techniques are reviewed. The discrete Fourier transform (DFT), defined in a finite field or ring, and applicable number theory concepts, are used to describe the number theoretic transform (NTT) and its circular convolution properties. The considerations in the selection of a modulus that results in efficient modular arithmetic on a binary computing device are discussed. The limitations in transform length are presented, along with means for overcoming this restriction. The complex number theoretic transform (CNT) defined in both a finite field and ring is described. Finally, the computational efficiency of NTT vs FFT convolution is discussed. GRA

N76-17895# California Univ., Berkeley. Electronics Research Lab.
THE RAYLEIGH QUOTIENT ITERATION FOR NON-NORMAL MATRICES Final Scientific Report. Ph.D. Thesis
Nai-fu Chen 2 Oct. 1975 84 p refs
(Contract N00014-69-A-0200-1017)
(AD-A016581; ERL-M548) Avail: NTIS CSCL 12/1

The Rayleigh Quotient Iteration (RQI) is a method for computing eigenvectors and eigenvalues of a square matrix. The behavior, both local and global, of RQI with symmetric and normal matrices is almost completely understood. The vector sequence converges for almost all starting vectors. In this paper, the author investigates the global properties of RQI on non-normal matrices. Results on nearly normal matrices with real eigenvalues are obtained, and at the other extreme, results on completely degenerate matrices are also obtained. In particular, the question of global convergence of the vector iteration on a general matrix is reduced to the convergence of the scalar sequence of the Rayleigh quotients. In practice, the vector iteration always converges. The main difficulty in the degenerate case is that the iteration function is discontinuous near the eigenvector. An example is used to display the sectorial behaviour of the iteration. Further the author constructs a sequence of numbers that converges to the eigenvalue. Yet if the numbers are used as shifts with inverse iteration, the vector sequence fails to converge. GRA

N76-17896# Wisconsin Univ., Madison. Mathematics Research Center.
EFFECT OF DISCONTINUOUS BOUNDARY CONDITIONS ON FINITE-DIFFERENCE SOLUTIONS Summary Report
J. Barkley Rosser Jun. 1975 43 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-A016348; MRC-TSR-1383) Avail: NTIS CSCL 12/1

If one is solving a Laplace differential equation by the standard 5-point or 9-point difference approximation, a discontinuity of the boundary values will cause the approximate solution to be in error in the interior. The amount and nature of these errors is discussed, and it is shown that a properly chosen 9-point approximation yields greater accuracy than a 5-point approximation for certain problems of this type. GRA

N76-17897# Wisconsin Univ., Madison. Mathematics Research Center.
CALCULATION OF POTENTIAL IN A SECTOR, PART 1 Summary Report
J. Barkley Rosser May 1975 71 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-A016349; MSR-TSR-1535-Pt-1) Avail: NTIS CSCL 12/1

More and more practical problems are requiring the solution of potential problems in L-shaped regions, T-shaped regions, and worse. There seems still a dearth of wholly satisfactory means for getting numerical approximations in these cases. The present report will provide a useful tool for getting such numerical approximations; it will also provide a better theoretical understanding of the problems. The tool developed in this report is to provide means for the rapid calculation of u(x,y) at points inside a sector if u(x,y) is a harmonic function which is required to assume given values around the boundary. For the present Part I, these boundary values are required to be quite smooth. GRA

N76-17898# Wisconsin Univ., Madison. Dept. of Computer Sciences.
COLLOCATION FOR SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS
John H. Cerutti Dec. 1974 21 p refs
(Contract N00014-67-A-0128-0004)
(AD-A016676; TR-230) Avail: NTIS CSCL 12/1

C. de Boor and B. Swartz have shown that by using C sup (M-1) piecewise polynomials of order k - m the C sup (M-2k) solution of an m-th order non-linear differential equation can be approximated to within O(absolute value/delta/sup(k-m)) globally and O (absolute value/delta/sup 2k) at the knots by collocation at Gaussian points. An extension of their results to systems of nonlinear equations is given. GRA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N76-17899 Ohio State Univ., Columbus.
THE STOCHASTIC PROPERTIES OF THE WEIGHTS IN AN ADAPTIVE ANTENNA ARRAY Ph.D. Thesis
George Edmund Koleszar 1975 108 p
Avail: Univ. Microfilms Order No. 76-3474

The least mean square feedback algorithm was used in the analysis. The input signal at the control loop is modelled as a cw signal corrupted by additive, narrowband, Gaussian noise. The weight differential equation for a single loop array was developed and three approaches investigated to solve for the weight statistics. These are (1) the direct approach, (2) the Ito approach which models the weight differential equation in terms of an Ito equation, and (3) the stochastic perturbation approach in which the weight solution is written as a power series in epsilon where epsilon is a small parameter. Expressions for the mean and variance of the weights were developed and compared.

The application of stochastic perturbation theory is shown to provide a straightforward solution to the random coefficient problem when the noise is small compared to the desired signal. It also uncouples the vector weight equation for the N-element case. Dissert. Abstr.

N76-17900# Pennsylvania State Univ., University Park. Coll. of Business Administration.

UTILITY INDEPENDENCE WITH INCOMPLETE PRODUCT SETS

Peter C. Fishburn Sep. 1975 24 p refs
(Contract N00014-75-C-0857; NR Proj. 047-112)
(AD-A015313; TR-16) Avail: NTIS CSCL 12/2

U is a von Neumann-Morgenstern utility function on a consequence set T which is a subset of a product set A x X. Extending Keeney's definition, it is said that X is utility independent of A if there are real valued functions f and g on A, with g positive, and a real valued function h on X such that u(a,x) = f(a) + g(a)h(x) for all (a,x) in T. Necessary and sufficient conditions for utility independence were given. Conditions were investigated for utility independence when T is an arbitrary subset of A x X. The strongest of three increasingly stronger conditions on preferences between gambles is shown to be necessary and sufficient for utility independence when T is finite. Examples are given to show that this condition is not generally sufficient when T is infinite. Author

N76-17901# Pennsylvania State Univ., University Park. Coll. of Business Administration.

ON THE FOUNDATIONS OF MEAN-VARIANCE ANALYSIS

Peter C. Fishburn Sep. 1975 21 p refs
(Contract N00014-75-C-0857; NR Proj. 047-112)
(AD-A015315; TR-18) Avail: NTIS CSCL 12/2

It is well-known that choices among risky options that are based on means and variances of the probability distributions associated with the options encounter serious logical difficulties unless suitable restrictions are imposed on the relevant distributions. Despite this, clear statements of the logical implications of basic presuppositions of mean-variance analysis have not appeared in the literature. This report offers such statements for the context in which outcomes are not bounded, and the context in which all outcomes lie within a fixed finite interval. 'Reasonable' assumptions in the unbounded case imply a lexicographic choice model with means as the dominant factor and variances as the secondary factor. However, tradeoffs between mean and variance are possible in the bounded outcomes context although the slopes of the resultant tradeoff curves are restricted in a precisely described way. GRA

N76-17902# Pennsylvania State Univ., University Park. Coll. of Business Administration.

A THEORY OF SUBJECTIVE EXPECTER UTILITY WITH VAGUE PREFERENCES

Peter C. Fishburn Sep. 1975 39 p refs
(Contract N00014-75-C-0857; NR Proj. 047-112)
(AD-A015312; TR-15) Avail: NTIS CSCL 12/2

This report shows how notions of vagueness in preferences and judgments of personal probabilities can be accommodated within an axiomatization of subjective expected utility by the use of scaling probabilities and lotteries on consequences. The representation obtained says that the subjective expected utility of one act exceeds the subjective expected utility of a second act whenever the first is preferred to the second. The report also explores the possibility of obtaining this representation without using scaling probabilities. GRA

N76-17903# Illinois Univ., Urbana. Dept. of Computer Science.

A STOCHASTIC CONTROL SYSTEM

James R. Cutler and David Ficke Jun. 1975 22 p refs
(Contract N00014-67-A-0305-0024)
(AD-A015286; UIUCDCS-R-75-752) Avail: NTIS CSCL 14/2

This paper is concerned with a control system that uses stochastic sequences as the means to reach the steady-state point. The main part of the system is a temperature transducer which outputs a stochastic sequence. The time average of the stochastic sequence is dependent upon the temperature. This sequence is then used to control a heater. A description of this system is included in this paper as well as the appropriate theory and results. A system was also constructed. GRA

N76-17904# Pennsylvania State Univ., University Park. Coll. of Business Administration.

BINARY CHOICE PROBABILITIES BETWEEN GAMBLES: INTERLOCKING EXPECTED UTILITY MODELS

Peter C. Fishburn Sep. 1975 47 p refs
(Contract N00014-75-C-0857; NR Proj. 047-112)
(AD-A015314; TR-17) Avail: NTIS CSCL 12/2

This report discusses two models for describing an individual's binary choice probabilities between gambles whose outcomes are measured along a unidimensional scale on which a larger outcome is preferred to a smaller outcome. The models presume an underlying von Neumann-Morgenstern utility function. They view each pair of gambles in an interlocking fashion rather than as two separate entities. The first model is an incremental expected utility advantage model designed for the context in which the outcome probabilities are not associated with specific chance events. The second model is a generalization of Edwards' RELM rule that is intended for contexts in which outcome probabilities are tied to designated chance events. Data from previous studies lends some support to the models as descriptors of binary choice probabilities in risky decision making. GRA

N76-17905# Texas Univ., Austin. Center for Cybernetic Studies.

DOMINATION STRUCTURES AND MULTICRITERIA PROBLEMS IN n-PERSON GAMES

K. Bergstresser and P. L. Yu Jul. 1975 67 p refs
(Contract N00014-75-C-0569; NR Proj. 047-021)
(AD-A015609; CCS-234) Avail: NTIS CSCL 12/2

Multiple criteria decision problems with one decision maker have been recognized and discussed in the recent literature in optimization theory, operations research and management science. The corresponding concept with n-decision makers, namely multicriteria n-person games, has not yet been extensively explored. In this paper the authors first demonstrate that existing solution concepts for single criterion n-person games in both normal form and characteristic function form induce domination structures (similar to those defined and studied by Yu for multicriteria single decision maker problems) in various spaces, including the payoff space, the imputation space and the coalition space. The authors then illustrate that a multicriteria problem can naturally arise in decision situtations involving (partial) conflict among n-persons. GRA

N76-17906# Yale Univ., New Haven, Conn. Dept. of Statistics.

DISTRIBUTION OF THE KURTOSIS STATISTIC B2 FOR NORMAL SAMPLES

Francis J. Anscombe and William J. Glynn Aug. 1975 15 p refs
(Contract N00014-75-C-0563; NR Proj. 042-242)
(AD-A015419; TR-37) Avail: NTIS CSCL 12/1

D'Agostino and Pearson (Biometrika, 1973) give percentage points of the distribution of (b sub 2) for independent observations from a common normal distribution. Their results can be well approximated, when the first three moments of the distribution of (b sub 2) have been determined, by fitting a linear function of the reciporcal of a chi square variable and then using the Wilson-Hilferty transformation. For residuals in the additive analysis of a two-way table, the third and fourth moments of (b sub 2) are related in almost the same way as for the homogeneous sample, which is ground for hope that the approximation will be equally good. GRA

N76-17907# Naval Postgraduate School, Monterey, Calif.

NON-PARAMETRIC QUANTILE ESTIMATION THROUGH STOCHASTIC APPROXIMATION Ph.D. Thesis

David Walter Robinson Jun. 1975 233 p refs
(AD-A014628) Avail: NTIS CSCL 12/1

The extreme values which a random variable X may take on are usually best characterized by the quantiles of the random variable. Known non-parametric methods for the statistical estimation of extreme quantiles all suffer from serious shortcomings, however. In this thesis a robust and efficient method for quantile estimation is described; both the asymptotic and finite

sample properties of the estimator are determined and computer implementations are given. Possible applications for the technique include the analysis of computer simulations and data analysis in large data bases or real time computer systems. GRA

N76-17908# Florida State Univ., Tallahassee.
TREATMENT CONTRASTS IN PAIRED COMPARISONS. 1: BASIC PROCEDURES WITH APPLICATION TO FACTORIALS
Ralph A. Bradley and Abdalla T. El-Helbawy Jul. 1975 22 p refs
(Contract N00014-67-A-0235-0006)
(AD-A014715; FSU-Statistics-M348; TR-99-ONR) Avail: NTIS CSCL 12/1

A simple procedure for consideration of specified treatment contrasts or sets of contrasts in a paired comparisons experiment is developed. General likelihood estimation and likelihood ratio tests are given. Specified treatment comparisons as appropriate in a particular experiment may be made. The procedure may be used for consideration of factor effects and interactions when the treatments in paired comparisons are factorial treatment combinations. An example is given of a taste preference experiment on coffee with factors, brew strength, roast color and brand, each at two levels. Results are summarized in an analysis of chi-square table very analogous to the typical analysis of variance summary. GRA

N76-17909# Florida State Univ., Tallahassee. Dept. of Statistics.
HUBER-SENSE ROBUST-M-ESTIMATION OF A SCALE PARAMETER, WITH APPLICATION TO THE EXPONENTIAL DISTRIBUTION
R. J. Serfling and Peter F. Thall Jul. 1975 24 p refs Sponsored in part by NIH
(Contract N00014-67-A-0235-0006)
(AD-A014714; FSU-Statistics-M347; TR-98-ONR) Avail: NTIS CSCL 12/1

A theory of robust m-estimation of a location parameter was developed by Huber and applied to estimation of the mean of a normal distribution. This theory is applicable to the problem of robust estimation of a scale parameter, since nonnegative data X having scale parameter theta may be transformed by y equals log x into data Y having location parameter log theta. Huber's location parameter results are reformulated in the scale parameter context--that is, the theorems are transformed instead of the data--and the results are applied in connection with the problem of robust estimation of the parameter theta of the exponential distribution, 1 - exp(-x/theta), x greater than 0. Whereas the maximum likelihood estimator of theta is the sample mean, the robust m-estimator, which is the solution of a minimax problem based on the asymptotic variance criterion, turns out to be a type of Winsorized mean. Numerical illustration is provided using a data set consisting of the time intervals between successive failures of the air conditioning systems of a fleet of jet airplanes. Author (GRA)

N76-17910# Florida State Univ., Tallahassee. Dept. of Statistics.
SUFFICIENCY, MINIMAL SUFFICIENCY, AND THE LACK THEREOF
Allan Sampson and Bruce Spencer May 1975 10 p refs
(Contract N00014-67-A-0235-0006)
(AD-A014716; FSU-Statistics-M342; TR-95-ONR) Avail: NTIS CSCL 12/1

This paper presents at an elementary level a unified presentation of concepts related to sufficiency and minimal sufficiency. Extensively discussed are techniques for showing in a particular statistical model that a given statistic is not sufficient or that a given sufficient statistic is not minimal. The applicability of these techniques is illustrated in three examples. GRA

N76-17911# Army Research Inst. for the Behavioral and Social Sciences, Arlington, Va.
A MODEL FOR USING QUALITATIVE VARIABLES AS COVARIATES IN THE ANALYSIS OF COVARIANCE Final Report
N. Phillip Ross Jul. 1975 47 p refs
(DA Proj. 2Q7-62717-A-745)
(AD-A014936; ARI-Tech-Paper-266) Avail: NTIS CSCL 12/1

The powers of fixed effects randomized block (RB) and analysis of covariance (CANCOVA) using qualitative concomitant variables were analytically and empirically compared. Analytical comparisons were made of the powers of RB and CANCOVA in which the number of observations (n sub i) within each of the I categories of the concomitant variable was a constant. Empirical comparisons were made of the power of CANCOVA in which (n sub i) was a random variable (RCANCOVA) with RB in which (n sub i) was a constant. A Monte Carlo program simulated fixed effects with two levels of treatment, one criterion variable, and a qualitative concomitant variable with I categories. Three 'design types' in which I was equal to 2, 3, and 4 were studied. The parameters varied for each design type were: (1) total sample size (n..) (I=2, n..=20, 80; I=3, n..=36, 144; I=4, n..=56, 224); (2) ratio of number of row observations (I=2, 1:1, 4:1; I=3, 1:1:1, 4:1:1; I=4, 1:1:1:1, 4:1:1:1); (3) eta (0.0, 0.3, 0.9); and (4) magnitude of treatment effect (0.0, 0.2, 0.5). Analytically, the RB and CANCOVA provided the same information in terms of component sums of squares. However, the power relationship was shown to be a function of sample size, design type, and amount of heterogeneity (interaction) present. Empirically no interpretable differences were found, either in magnitude and direction, between the power of the RB and RCANCOVA for any of the design type and parameter combinations studied. Author (GRA)

N76-17912# Desmatics, Inc., State College, Pa.
A RIDGE ANALYSIS CAVEAT
Dennis Smith Sep. 1975 13 p refs
(Contract N00014-75-C-1054; NR Proj. 042-334)
(AD-A015324; TR-106-1) Avail: NTIS CSCL 12/1

The experimenter concerned with obtaining optimum conditions may use ridge analysis to analyze a fitted second order surface. Unfortunately, unthinking 'cookbook' application of ridge analysis may give misleading results. This report discusses some situations which illustrate this. GRA

N76-17913# Southern Methodist Univ., Dallas, Tex. Dept. of Statistics.
MEAN SQUARED ERROR PROPERTIES OF REGRESSION ESTIMATORS
Richard F. Gunst and Robert L. Mason 1975 38 p refs
(Grant AF-AFOSR-2871-75; AF Proj. 9769)
(AD-A015392; AFOSR-75-1384TR) Avail: NTIS CSCL 12/1

Mean squared error is used to compare five regression estimators: Least Squares, Principal Components, Ridge Regression, Latent Root, and a Shrunken estimator. Each of the biased estimators is shown to offer improvement in mean squared error over Least Squares for a wide range of choices of the parameters of the model. Using the results of a simulation involving all five estimators, the Principal Components and Latent Root estimators are seen to perform best overall but the Ridge Regression estimator has the potential of a smaller mean squared error than either of these providing a better estimator of the ridge parameter can be found. GRA

N76-17914# University of Southern Calif., Los Angeles. Social Science Research Inst.
ELICITING SUBJECTIVE PROBABILITY DISTRIBUTIONS ON CONTINUOUS VARIABLES
David A. Seaver, Detlof V. Winterfeldt, and Ward Edwards 1 Aug. 1975 26 p refs
(Contract N00014-75-C-0487; ARPA Order 2105; NR Proj. 197-021)
(AD-A016828; USC-001597-3-T; SSRI-RR-75-8) Avail: NTIS CSCL 12/2

Five procedures for assessing subjective probability distributions over continuous variables were compared using almanac questions as stimuli. The procedures varied on the uncertainty measures used (probabilities, odds, and odds on a logarithmic scale) and the type of response required from the subjects (uncertainty measure or value of the unknown quantity). The results showed the often used fractile procedures were inferior to procedures requiring probabilities or odds as the response from subjects. The results are also discussed in terms of the 'anchoring and adjustment' hypothesis. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N76-17915 Cincinnati Univ., Ohio.
DESIGN OF MINIMUM COST CENTRALIZED COMPUTER COMMUNICATION NETWORKS Ph.D. Thesis
Roger Christian Seifried 1975 97 p
Avail: Univ. Microfilms Order No. 76-2346

A method, for the minimum cost design of a centralized computer communication network where the link cost is a function of both the link length and the link capacity, was developed. The capacities available for assignment to a link are constrained to a bounded set of values. The link cost is the product of the link length and the cost per unit length for its assigned capacity. The problem is formulated as a multicommodity flow with the required data rates from the network nodes to the central node being considered the commodity flows. An integer program is then developed for the multicommodity flow problem, and the solution is obtained through a branch and bound method. A topology mapping is developed based on a modification of Kruskal's minimum spanning tree which will map one topologically feasible structure into another topologically feasible structure. The topology mapping is used for the branching operation in the branch and bound method and is also used in developing a lower cost bound. Dissert. Abstr.

N76-17916*# Aerophysics Research Corp., Bellevue, Wash.
A DIFFERENTIAL GAME SOLUTION TO THE COPLANAR TAIL-CHASE AERIAL COMBAT PROBLEM Final Report
A. W. Merz and D. S. Hague Jan. 1976 57 p refs
(Contract NAS2-8844)
(NASA-CR-137809) Avail: NTIS HC $4.50 CSCL 12B

Numerical results obtained in a simplified version of the one on one aerial combat problem are presented. The primary aim of the data is to specify the roles of pursuer and evader as functions of the relative geometry and of the significant physical parameters of the problem. Numerical results are given in a case in which the slower aircraft is more maneuverable than the faster aircraft. A third order dynamic model of the relative motion is described, for which the state variables are relative range, bearing, and heading. The ranges at termination are arbitary in the present version of the problem, so the weapon systems of both aircraft can be visualized as forward firing high velocity weapons, which must be aimed at the tail pipe of the evader. It was found that, for the great majority of the relative geometries, each aircraft can evade the weapon system of the other. Author

N76-17917# Southern Methodist Univ., Dallas, Tex. Dept. of Industrial Engineering and Operations Research.
MEASURES OF PERFORMANCE FOR THE SYSTEM G/M/s/N WITH TWO CLASSES OF CUSTOMERS
U. Narayan Bhat and Sagi N. Raju Jul. 1975 25 p refs
(Contract N00014-75-C-0517; NR Proj. 042-324-436)
(AD-A015339; IEOR-75009) Avail: NTIS CSCL 17/2

The following queueing system is analyzed completely for its steady state measures of performance: the arrival epochs are in a recurrent process and an arriving customer belongs to either one of the two classes with probability p and 1-p respectively. The number of channels is 's' and the service time distribution is exponential with the same mean for all customers. The system capacity is N (greater than s) for the number of customers in the system. Arriving class 1 customers are buffered when all servers are busy. Arriving class 2 customers are denied access to the system when k (less than s) or more service channels are busy. This queueing model is used to represent a telecommunications network where data voice customers share access and line facilities. Author (GRA)

N76-17918# Southern Methodist Univ., Dallas, Tex. Dept. of Industrial Engineering and Operations Research.
AN IMBEDDED MARKOV CHAIN ANALYSIS FOR FINITE QUEUES: AN ANALYTICAL APPROACH TO NUMERICAL RESULTS
Sagi N. Raju and U. Narayan Bhat Jul. 1975 31 p refs
(Contracts N00014-72-A-0296-0003; N00014-75-C-0517; NR Proj. 042-324)
(AD-A015340; IEOR-75008) Avail: NTIS CSCL 12/2

Imbedded Markov chains of finite queueing systems with unit jumps at regeneration points have an almost left triangular (in systems of the type G/M/s/N - in Kendall notation modified to include system capacity) or an almost right triangular (in systems of the type M/G/1/N) structure. Using this structure a fundamental recursion on the elements of the transition probability matrix is developed, which in turn helps derive first passage as well as equilibrium results in computationally feasible forms. GRA

N76-17919# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
INTERFACE MESSAGE PROCESSORS FOR THE ARRA COMPUTER NETWORK Quarterly Technical Report, 1 Jan. - 31 Mar. 1975
Apr. 1975 83 p ref
(Contract F08606-75-C-0032; ARPA Order 2351)
(AD-A015190; BBN-3063; QTR-1) Avail: NTIS CSCL 09/2

The ARPA computer network is a packet-switching store-and-forward communications system designed for use by computers and computer terminals. This report describes aspects of the work in network operation; Terminal IMP access control and accounting; Private Line Interface design, construction, and checkout; Pluribus IMP construction and checkout; sizeable changes to the IMP message-processing algorithms; and Satellite IMP issues. The IMP message-processing algorithms have been completely redesigned and the operational IMPs are now using a message-block scheme on a Host-pair basis, rather than the previous IMP-pair message number scheme. The major topics addressed in the report on Satellite IMP progress are the Pluribus implementation and the acknowledgement scheme the authors have chosen for use on the broadcast channel. GRA

N76-17920# Princeton Univ., N.J. Dept. of Electrical Engineering.
DIGITAL SIGNAL PROCESSING THROUGH ON-LINE COMPUTATION Final Report, 1 Sep. 1968 - 30 Jun. 1975
J. B. Thomas and K. Steiglitz 19 Aug. 1975 15 p refs
(Contract DAHC04-69-C-0012)
(AD-A015584; ARO-7624.46-E) Avail: NTIS CSCL 09/4

A summary of research accomplishments is presented which includes investigations in digital filtering, digital signal processing, speech processing, graph and network algorithms, heuristic algorithms and applications to resource allocation problems, and the theory of algorithms. A listing of the participating personnel and a bibliography are included. M.J.S.

N76-17921# Stanford Univ., Calif. Dept. of Statistics.
OPTIMAL SYSTEM ALLOCATIONS WITH PENALTY COSTS
C. Derman, G. J. Lieberman, and S. M. Ross 29 Aug. 1975 16 p refs
(Contract N00014-75-C-0561; NR Proj. 042-002)
(AD-A016601; TR-171) Avail: NTIS CSCL 12/2

Assume that one has N stages to sequentially construct I successful components. At each stage one allocates a certain amount of money for the construction of a component. If y is the amount allocated then the component constructed will be a success with probability P(y), where P is a continuous nondecreasing function satisfying P(0) = 0. After each component is constructed one is informed as to whether or not it is successful. If, at the end of the N stages, there are i components short, then a final penalty cost C(i) is incurred. The problem is to, at each stage, determine how much money to allocate so as to minimize the total expected cost (construction cost plus penalty cost) incurred. This model is similar to that presented in another paper except for the cost function. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N76-17922# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
A NOTE ON SECOND ORDER CONDITIONS FOR PSEUDO-

CONVEXITY
V. Joseph Bowman and Terry C. Gleason May 1975 13 p refs
(Contract N00014-67-A-0317-0007; NR Proj. 047-048)
(AD-A014931; RR-365; WP-44-74-75) Avail: NTIS CSCL 12/1

Mereau and Paquet have given a necessary and a sufficient second order condition for pseudo-convexity. This note gives a necessary condition which is equivalent to the Mereau and Paquet result but which has the advantage of computational tractability because it employs the eigenvalues of the Hessian.
Author (GRA)

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N76-17923# Colorado State Univ., Fort Collins.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE MAGNETIZATION PROPERTIES AND BASIC ELECTROMECHANICS OF FERROFLUIDS
T. B. Jones and D. A. Krueger Sep. 1975 52 p refs
(Contract N00014-67-A-0299-0020; NR Proj. 097-390)
(AD-A016655) Avail: NTIS CSCL 07/4

The purpose of this study is to investigate the basic magnetization processes and properties of ferrofluids and to apply these findings to the magnetic-field-coupled hydrodynamics (i.e. ferrohydrodynamics) of these colloidal liquids. This document reports progress over the last 12-month period. In basic ferrofluid properties studies, the authors have discovered a previously unreported agglomeration effect in commercially available 200 Gauss water-base ferrofluid. Upon the application of a uniform or non-uniform magnetic field, A.C. (60 Hz) or D.C., and any strength from 5 Oe to 230 Oe (limited by experimental apparatus), the formation of large agglomerates of up to 10 to the 9th power magnetite particles and with diameters from 10 to 20 micrometers has been observed. Agglomerate size increases with the magnetic field strength. The larger agglomeration effect in water-base ferrofluid can be explained theoretically as due to the larger diameter particles present in water-base fluid. Other theoretical results include (1) a calculation of the particle size dependence of the minimum magnetic field which is necessary for two particles to agglomerate, and (2) an estimate for the growth of sinking agglomerates due to scavenging. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N76-17924 George Washington Univ., Washington, D.C.
ACTIVE REDUCTION OF LOW FREQUENCY SOUND FROM LARGE VIBRATING SURFACES Ph.D. Thesis
Allen Roger Davidson, Jr. 1975 172 p
Avail: Univ. Microfilms Order No. 76-3705

The problem of reducing detectable low frequency sound emitted by a large flat vibrating surface is investigated. The approach taken that is different from previous studies is to space an array of independent cancellation units over the surface. Each unit receives wideband sound in the near field next to the surface and drives its projector with a properly processed signal through an adaptive controller. The array units in turn produce a phase opposition far field pattern which reduces the low frequency sound pattern generated by the vibrating surface. The feasibility of active sound cancellation was determined by computer simulation and experimentation. A model of a single cancellation unit was developed for simulating two types of adaptive controllers which could track projector output to a phase opposing signal as best as possible within the linear limits of the unit. The results demonstrated that active sound reduction within certain boundary limitations is feasible, provided strict attention is paid to proper design of the cancellation units and to array geometry. Dissert. Abstr.

N76-17925*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A COMPUTER PROGRAM FOR THE DETERMINATION OF THE ACOUSTIC PRESSURE SIGNATURE OF HELICOPTER ROTORS DUE TO BLADE THICKNESS
G. H. Mall and F. Farassat Washington Jan. 1976 80 p refs
(NASA-TM-X-3323; L-10437) Avail: NTIS HC $5.00 CSCL 20A

A computer program is presented for the determination of the thickness noise of helicopter rotors. The results were obtained in the form of an acoutic pressure time history. The parameters of the program are the rotor geometry and the helicopter motion descriptors, and the formulation employed is valid in the near and far fields. The blade planform must be rectangular, but the helicopter motion is arbitrary; the observer position is fixed with respect to the ground with a maximum elevation of 45 deg above or below the rotor plane. With these restrictions, the program can also be used for the calculation of thickness noise of propellers. Author

N76-17926*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
ACOUSTIC ATTENUATION IN THE CASE OF SUBMICROSCOPIC DROPLETS
M. Jaeschke, W. H. Hiller, and G. E. A. Meier Washington NASA Jan. 1976 9 p refs Transl. into ENGLISH from Z. Angew. Math. Mech. (East Ger.), v. 55, Apr. 1975 p T133-T135
(Contract NASw-2789)
(NASA-TT-F-16857) Avail: NTIS HC $3.50 CSCL 20A

It was assumed that the acoustic wavelength is great in comparison to the distance between particles. It was, therefore, possible to consider, in addition to the vapor and the carrier gas (air), the droplets as a continuum. The relaxation processes which are connected with the exchange processes between particles and the surrounding gas determine the propagation characteristics and the attenuation of the acoustic waves. Attenuation coefficients computed on the basis of the derived theoretical relations are in satisfactory agreement with experimental values. Author

N76-17927*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
DISTRIBUTION TO THE STUDY OF AIR-JET ACOUSTIC GENERATORS
E. Brocher Washington NASA Feb. 1976 22 p refs Transl. into ENGLISH from Acoustica (Stuttgart), v. 32, Apr. 1975 p 227-235
(Contract NASw-2789)
(NASA-TT-F-16887) Avail: NTIS HC $3.50 CSCL 20A

The operation is explained of the acoustic air-jet generators, outside the region or in the absence of the Hartmann instability intervals, through the periodical boundary layer separation developed on objects placed in the air-jet. A new type of generator, working in these conditions, the needle generator is described. It was experimentally shown that its characteristics are great emission stability, high acoustical efficiency, and a purity of the emitted sound as high as 99 deg. Author

N76-17928*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVIDENCE OF THE BEAM PATTERN CONCEPT OF SUBSONIC JET NOISE EMISSION
S. Paul Pao and Lucio Maestrello Washington Feb. 1976 49 p refs
(NASA-TN-D-8104; L-10479) Avail: NTIS HC $4.00 CSCL 20A

The methods and results are described of an approach toward positively identifying the apparent location and strength of the sound source in a subsonic jet. The Green's function technique is applied to regenerate the three-dimensional distribution of the acoustic far field from measured data on a two-dimensional plane. The apparent sound-source location is also determined by using geometrical ray acoustics. The results revealed a number of features of the subsonic jet noise mechanisms; they show that the apparent sound source is highly localized within the jet flow

and that the spontaneous noise emission from such a compact source volume is in the fashion of a narrow beam with random directions. These observable properties of the sound field offer the basis for a beam pattern concept of subsonic jet noise radiation. A powerful and accurate technique of aerodynamic noise measurement is verified. This technique is expected to have important applications in the development of jet noise reduction technology. Author

N76-17336 European Space Agency, Paris (France).
THEORY OF THE ACOUSTIC FEEDBACK OF SUBSONIC FREE JETS WHICH IMPINGE ON OBSTACLES, AND COMPARISON WITH EXPERIMENTS
Guenther Neuwerth *In its* Pract. Probl. on Longitudinal and Cross-blown Free Jets (ESA-TT-206) Nov. 1975 p 84-97 refs Transl. into ENGLISH of 'Prakt. Probl. bei Freistrahlen mit Laengs- oder Queranblasung/Triebwerksstrahlsimulation in Windkanaelen', DGLR, Cologne Report DLR-Mitt-74-18, 1974 P 84-97 (For availability see N76-17332 08-34)

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N76-17929 Missouri Univ., Rolla.
CHARACTERIZATION OF HEAT-TREATED NICKEL AND GOLD FILMS ON SILICON SINGLE CRYSTALS Ph.D. Thesis
Ki Hyun Yoon 1975 134 p
Avail: Univ. Microfilms Order No. 76-3770

An experimental electron impact ionization source was used to determine the presence of various neutral atoms and molecules on metallized and bare surfaces of silicon wafers. The metallization consisted of thin films of nickel and gold separately and in combination. The major surface contaminates on all samples were found to be F, Na, Cl, K, CO, and CO2. The surface concentration of these species was found to be sensitive to the sample temperature up to 550 C, the maximum temperature used in this study. In the course of the mass spectrometric study, it was found that crystallites were formed on samples coated with nickel and gold films in combination. Several experimental methods were used to study these crystallites and to determine their origin. These methods included X-ray diffraction, scanning electron microscopy, and in-depth Auger electron spectroscopy. The crystallites were identified as NiSi2. Diffusion appeared to be important to the formation of the NiSi2. In-depth Auger electron spectroscopy was used to study the diffusion kinetics of nickel in silicon. Dissert. Abstr.

N76-17930# United Aircraft Corp., East Hartford, Conn.
THEORETICAL DETERMINATION OF METAL OXIDE F NUMBERS Final Report, Jun. 1971 - Sep. 1974
H. Harvey Michels Kirtland AFB, N. Mex. AFWL May 1975 51 p refs
(Contract F29601-71-C-0119; AF Proj. 5710; DNA Proj. NWED-QAXH)
(AD-A015096; AFWL-TR-74-239) Avail: NTIS CSCL 07/4

The release of certain chemical species into the upper atmosphere results in luminous clouds that display the resonance electronic-vibrational-rotation spectrum of the released species. Such spectra are seen in rocket releases of chemicals for upper atmospheric studies and upon reentry into the atmosphere of artificial satellites and missiles. Of particular interest in this connection is the observed spectra of certain metallic oxides. From band intensity distribution of the spectra, and knowledge of the f-values for electronic and vibrational transitions, the local conditions of the atmosphere can be determined. Calculations have been performed for band-to-band transition probabilities. The systems under study were LIO, ALO, FEO, UO and, UO and TIO. Electronic wave-functions have been constructed for selected states of these molecules and expectation values of the electronic energy and electric dipole transition moments have been calculated. GRA

N76-17931# United Technologies Research Center, East Hartford, Conn.
CALCULATION OF ELECTRONIC WAVE-FUNCTIONS Final Report, 1 Jun. 1974 - May 1975
H. Harvey Michels Aug. 1975 88 p refs
(Contract F44620-74-C-0083; AF Proj. 9750)
(AD-A015428; R75-921948; AFOSR-75-1429TR) Avail: NTIS CSCL 07/4

Calculations have been performed for band-to-band transition probabilities. The molecules under study were CuO, CrO, NiO, ThO and ThO(+). Electronic wave-functions have been constructed for selected states of these molecules and expectation values of the electronic energy and electric dipole transition moments have been calculated. The calculated electric dipole transition moments were combined with numerical vibrational-rotational wavefunctions, based on RKR potential functions, to yield estimates of the system f-numbers. GRA

N76-17932# Utah Univ., Salt Lake City. Dept. of Chemistry.
ULTRASONIC ABSORPTION KINETIC STUDIES OF THE COMPLEXATION OF AQUEOUS POTASSIUM AND CESIUM IONS BY 18-CROWN-6
Gerard W. Liesegang, Michael M. Farrow, Neil Purdie, and Edward M. Eyring 10 Sep. 1975 31 p refs
(Contract N00014-75-C-0796; NR Proj. 051-556)
(AD-A015279; TR-5) Avail: NTIS CSCL 07/4

Reaction rate constants for a rapid conformational rearrangement of aqueous 18-crown-6 (1,4,7,10,13,16-hexaoxacyclooctadecane) and its slower complexation of potassium ions at 25C in aqueous solutions have been determined from ultrasonic absorption data covering the 9-340 MHz frequency range. A concentration independent absorption with a maximum at about 100 MHz occurs in aqueous solutions of 18-crown-6 with no alkali metal cations present. This relaxation was attributed to a conformational rearrangement of the crown ether. Complexation of aqueous potassium ion by the polyether was then investigated kinetically at various polyether and potassium ion concentrations. These data, together with the conformational rearrangement data, were analyzed in terms of two step mechanism. GRA

N76-17933# Missouri Univ., Rolla.
RADIO FREQUENCY SPECTROSCOPY OF PENNING IONS, MEASUREMENT OF ION AND MOLECULAR LIFETIMES Progress Report, 1 Oct. 1974 - 30 Sep. 1975
Richard A. Anderson and Laird D. Schearer 1 Oct. 1975 81 p refs
(Contract N00014-75-C-0477; NR Proj. 393-011)
(AD-A015099) Avail: NTIS CSCL 07/4

The radiative lifetime of some doublet P(3/2) states of metal atomic ions has been measured in a flowing helium afterglow by using the method of zero field level crossing (Hanle effect). The use of the flowing helium afterglow provides an efficient means for producing the ions to be studied (by Penning Ionization) in an environment where system parameters can be easily modified. The optical emission spectra of I sub 2 obtained in the flowing afterglow have been observed. A pulsed xenon ion laser and its application as a pump source for a tunable dye laser is described. The lifetime of the rotational levels of the v prime = o, 1, and 2 levels of the A sq. delta state of CH have been measured. The rotational lifetimes of the v prime level of the B sq. sigma state of CH have also been examined. The results of lifetime measurements of the 14, 15 & 16th rotational levels of this state enable us to determine that the potential barrier height for tunneling through the shallow potential maximum of the B sq. sigma state was greater than 700 ft/cm. GRA

N76-17934# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
ELECTRONIC SPECTRA OF LARGE MOLECULES Final Report
Robin M. Hochstrasser 20 Aug. 1975 8 p refs
(Grant DA-ARO(D)-31-124-72-G138)
(AD-A015590; ARO-10646.7-C) Avail: NTIS CSCL 07/4

The report very briefly describes research which was to explore various electric field effects on the spectra and behavior of organic molecules in the condensed phase. GRA

N76-17935# Stanford Research Inst., Menlo Park, Calif.
INELASTIC COLLISIONS OF EXCITED ATOMS Final Report, 1 May 1970 - 30 Jun. 1975
Thomas M. Miller 30 Sep. 1975 6 p refs
(Contract N00014-70-C-0339; NR Proj. 012-135; SRI Proj. PYU-8658)
(AD-A015373; SRI-MP-75-48) Avail: NTIS CSCL 07/3

Studies of the interaction of metastable atoms with ground state atoms are briefly reported. Experimental and theoretical research has been performed for excitation transfer, ionization, and charge transfer in collisions involving metastable atoms. The energy range covered is from a few eV up to several keV. GRA

N76-17936# Cornell Univ., Ithaca, N.Y. Dept. of Chemistry.
METASTABLE IONS IN MASS SPECTRA Final Report, 1 Apr. 1969 - 1 Jul. 1975
Fred W. McLafferty 12 Aug. 1975 8 p refs
(Grants DA-ARO(D)-31-124-G1117; DA-ARO(D)-31-124-72-G180)
(AD-A015575; ARO-8245.17-C) Avail: NTIS CSCL 07/4

Briefly described is research on instrumentation and techniques which have been developed to study the unimolecular decompositions of mass-analyzed gaseous organic ions, including those produced by metastable decompositions and collisional activation (CA). CA spectra provide a unique new method for the characterization of the molecular structures of ions, independent of their internal energy. This has been applied to a wide variety of organic ions. GRA

N76-17937# National Bureau of Standards, Washington, D.C.
POTENTIAL ENERGY SURFACES FOR AIR TRIATOMICS. VOLUME 1: LITERATURE REVIEW Final Report, Apr. 1972 - Apr. 1975
M. Krauss, D. G. Hopper, P. J. Fortune, A. C. Wahl, and T. O. Tiernan Jun. 1975 219 p refs Prepared in cooperation with NAS-NRC and Argonne Natl. Lab., Ill.
(Contracts F33615-72-M-5016; F33615-72-M-5015)
(AD-A014741; ARL-75-0202-Vol-1) Avail: NTIS CSCL 07/4

An extensive literature review on the potential energy surfaces of fifteen atmospheric triatomic molecular systems has been made. The systems are water, nitrogen dioxide, ozone, carbon dioxide, nitrous oxide, and their singly charged positive and negative ions. The potential energy surface characteristics for each molecular system are summarized in the form of adiabatic correlation diagrams between the electronic states of the triatomic molecule and those of the atom, diatomic asymptotes. Where available information allows, such correlation diagrams are constructed not only for the equilibrium symmetry and geometry of the triatomic ground state, but also for other symmetries and geometries as appropriate to the clear indication of the three-dimensional surface characteristics and the general adiabatic asymptotic correlations. The correlation diagrams for each system are discussed in connection with some of its triatomic and atom-diatomic processes. GRA

N76-17938# Avco-Everett Research Lab., Everett, Mass.
EXCIMER LASER RESEARCH Semiannual Technical Report, 15 Aug. 1974 - 15 Feb. 1975
C. A. Brau and J. J. Ewing Aug. 1975 52 p refs
(Contract N00014-75-C-0063; ARPA Order 1806)
(AD-A016606) Avail: NTIS CSCL 07/4

This report describes a theoretical and experimental investigation of the rare gas monohalides. As a class, these molecules show great promise for achieving high power scalable laser action in the near UV portion of the spectrum. A theory has been developed to describe the structure of these molecules. The predictions of this theory are borne out by fluorescence experiments carried out in high pressure rare gas/halogen mixtures, using electron-beam excitation. The kinetics of these mixtures and their potential as high power lasers are discussed. GRA

N76-17939# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
MOLECULAR-ORBITAL STUDIES OF TRANSITION AND NOBLE-METAL CLUSTERS BY THE SCF-X ALPHA SCATTERED-WAVE METHOD
K. H. Johnson , J. B. Diamond , C. Y. Yang , R. P. Messmer (GE, Schenectady, N. Y.), and S. K. Knudson (GE, Schenectady, N. Y.) 15 Oct. 1975 74 p refs Submitted for publication (Contracts N00014-75-C-0970; F44620-72-C-0008; NR Proj. 056-596)
(AD-A016289; TR-1) Avail: NTIS CSCL 07/4

The electronic structures of small copper, nickel, palladium, and platinum clusters having simple-cubic and cubo-octahedral geometries have been calculated, using the self-consistent-field X-alpha scattered-wave approach to molecular-orbital (MO) theory. As the cluster size and coordination number are increased, the MO results show increasing similarity to the electronic structures of the corresponding crystalline metals. The calculated ionization potentials decrease gradually with increasing cluster size and for the 13-atom cubo-octahedral clusters are approximately 2 eV greater than the corresponding average bulk work functions. Localized d-electron states are also observed for the cubo-octahedral transition-metal clusters. They appear to be cluster analogs of the 'surface states' postulated for crystalline transition metals and probably play an important role in the chemisorption and catalytic activities of small metal aggregates of the type utilized as the active centers of heterogeneous catalysts. The SCF-Xalpha-SW MO results for transition-metal clusters are critically compared with those obtained for similar clusters by the extended-Huckel (EH) and complete-neglect-of-differential-overlap (CNDO) methods. The implications of these results in surface-cluster studies of chemisorption on transition metals are discussed. GRA

N76-17940# National Bureau of Standards, Washington, D.C. Heat Div.
MOLECULAR DYNAMICAL STUDIES OF THE PROPERTIES OF SOLIDS UNDER PRESSURE Final Report, 1 Aug. 1974 - 31 Jul. 1975
D. H. Tsai and R. A. MacDonald 19 Sep. 1975 8 p
(DA Proj. 1T1-61102-B-11B)
(AD-A016307; ARO-10250.3-P; FR-2) Avail: NTIS CSCL 20/13

The long-range objective of this project is to develop and apply the method of molecular dynamics to the study of the thermodynamic and transport properties of solids under high-pressure, high-temperature conditions, such as those encountered in the shock compression of a solid or in the detonation of a reacting material. The main objective of the past year was to study the transport of thermal energy in a solid under steady and pulsed heating. The purpose is to compare the molecular dynamical results with existing results so as to obtain a critical evaluation of the basic molecular dynamical method. In addition, the phenomenon of second sound observed in our earlier calculations of the shock compression of a solid might be understood. GRA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

N76-17941# Naval Research Lab., Washington, D.C.
AUTOACCELERATION OF INTENSE ELECTRON BEAMS BY COAXIAL STRUCTURES Interim Report
John G. Siambis Aug. 1975 19 p refs
(AD-A015307; NRL-MR-3107) Avail: NTIS CSCL 20/7

Tonk's theorem and Faraday's law are applied to study the autoacceleration interaction of an intense hollow beam with a coaxial transmission line cavity, assuming the constant-current approximation. The autoacceleration voltage is found proportional to the beam current and the inductance per unit length of the coaxial transmission line. Comparison with experimental data indicates that the coupling coefficient alpha is of the order 1/2. The creation of a virtual cathode near the autoacceleration region under certain beam and geometry conditions gives rise to a virtual cathode acceleration voltage. This voltage is found to be proportional to the inductance per unit length of the annular region between the hollow beam and the drift tube as well as

the amount of charge per unit length reflected from the virtual cathode. GRA

N76-17942# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE EFFECTS OF THE EVALUATOR ASSIGNED NITROGEN NUCLEAR CROSS SECTION UNCERTAINTIES UPON THE TRANSPORT OF NEUTRONS IN AIR Final Report
William B. Beverly, Andrus Niler, and Norman E. Banks Sep. 1975 107 p refs
(DA Proj. 1W1-62118-AH-75)
(AD-A016883; BRL-1830) Avail: NTIS CSCL 20/6

The sensitivity of the transport of 14-MeV neutrons in sea level air to uncertainties in the ENDF/B-III values of the various Nitrogen cross sections has been calculated using the correlated sampling Monte Carlo neutron transport code SAMCEP. The source consisted of a 14.0 to 15.0-MeV band of isotropic neutrons and the fluences (0.5-15.0-MeV) were calculated at radii from 50 to 1500 meters. Various perturbations were assigned to the ENDF/B-III or base cross section set. They were: (1) a 5% increase to the elastic cross section with a corresponding decrease in the inelastic cross section, (2) a 3% decrease in the elastic cross section with an equivalent increase in the inelastic cross section, (3) the smoothing of the valley in the elastic cross section around 11 MeV with compensating changes taken in adjustments among the other partial cross sections, (4) a 10% increase in the elastic cross section with 2% of the compensating change being taken in the total cross section and the remainder absorbed in the inelastic cross section, (5) a 10% increase in the elastic cross section with the compensating change taken totally in the inelastic cross section, (6) an increase of 20% in the first Legendre coefficient and an increase of 10% in the second coefficient of the elastic scattering angular distribution and (7) a decrease of 10% in both the first and second Legendre coefficients of the elastic scattering. Transport calculations were carried out using various physically realistic sets of perturbed cross sections, bounded by evaluator-assigned uncertainties, as well as the base set. GRA

74 OPTICS

Includes light phenomena.

N76-17943# Army Electronics Command, Fort Monmouth, N.J.
INCOMPLETE GAMMA FUNCTION APPROXIMATION FOR KING'S STRONG LINE TRANSMITTANCE MODEL
Richard B. Gomez and Joseph H. Pierluissi (Texas Univ., El Paso) Jul. 1975 12 p refs
(DA Proj. 1T6-2111-AH-71)
(AD-A015522; ECOM-5567) Avail: NTIS CSCL 07/4

An approximation to the incomplete gamma function is presented for use with King's model for strong-line molecular transmittance through gases in the infrared. The approximating function circumvents computational problems inherent with the infinite series representation of the incomplete gamma function or of its derivations. A mean transmittance deviation from the series of 0.0002 is obtained over the range of variables of interest in atmospheric applications. GRA

N76-17944# Washington Univ., Seattle. Dept. of Electrical Engineering.
OPTICAL COUPLER DEVELOPMENT Annual Report, 1 Mar. 1973 - 28 Feb. 1975
30 Jun. 1975 10 p refs
(Contract N00123-73-C-1200)
(AD-A015319) Avail: NTIS CSCL 20/6

This report summarizes contract progress and optical coupler development and fiber optic strength improvement programs. Results and fabrication techniques are reported for a transition structure which varies in cross-section from rectangular (matching doubleheterostructure laser active areas) to round geometries similar to single mode fiber cross-sections. Distributed couplers for use with electro-optic modulators produced on substrates which do not cleave easily are also discussed. Preliminary results of long-gauge length fiber strength testing and strength improvement are summarized and lithium tantalate post-deposition microstructure modification results are presented. GRA

N76-17945# Riverside Research Inst., New York.
A STUDY OF MILLIMETER AND SUBMILLIMETER WAVE ATTENUATION AND DISPERSION IN THE EARTH'S ATMOSPHERE Final Technical Report, 19 Mar. - 15 Aug. 1975
M. Greenebaum and D. Koppel 15 Aug. 1975 46 p refs
(Contract DAAH01-74-C-0419; DARPA Order 2281)
(AD-A015544; RRI-F-1/306-3-14) Avail: NTIS CSCL 20/6

A summary is presented of new calculations of atmospheric absorption line parameters and of a slant-path absorption model slam; intended for use in the millimeter and submillimeter wave spectral regions. Results of a literature survey concerning altitude-dependent attenuation and dispersion in this spectral region, as well as weather-dependent scattering and fading strengths, are also summarized. Recommendations are given for reducing the uncertainties in the model predictions. A list of 318 absorption lines of the molecular oxygen isotopes of principal concern in atmospheric transmission below 300/cm is included, together with their integrated strengths at 296 K, line widths, lower-state energies, and identifying quantum numbers, in the format of the AFCRL Atmospheric Absorption Line Parameters Compilation. GRA

N76-17946# Hughes Research Labs., Malibu, Calif.
COMPUTER SIMULATION OF ADAPTIVE OPTICAL SYSTEMS Final Technical Report, 25 Mar. - 24 Oct. 1974
W. P. Brown, Jr. Sep. 1975 96 p refs
(Contract N60921-74-C-0249)
(AD-A015289) Avail: NTIS CSCL 20/6

In this report the authors discuss adaptive phase compensation for the effects of turbulence and thermal blooming. Closed-loop systems employing both outgoing-wave and return-wave control algorithms are considered, although the authors have obtained quantitative estimates of system performance only for the return wave-type of system. On the basis of results obtained from a computer simulation of such systems, they conclude that adaptive optical systems employing a return-wave control policy will yield only limited compensation for the effects of cw thermal blooming unless the target has glints that are significantly smaller than the diffraction-limited width of the beam. Analytical and computer simulation results have also been obtained for the dependence of mirror fit on the number of mirror actuators. GRA

N76-17947# Xonics, Inc., Van Nuys, Calif.
THEORETICAL STUDIES OF HIGH-POWER ULTRAVIOLET AND INFRARED MATERIALS Technical Report, 6 Dec. 1974 - 30 Jun. 1975
M. Sparks and C. J. Duthler 30 Jun. 1975 257 p refs
(Contract DAHC15-73-C-0127; ARPA Order 1969)
(AD-A016664; TR-5) Avail: NTIS CSCL 20/6

Contents: Current status of electron-avalanche-breakdown theories; Preliminary theory of electron-avalanche breakdown in dielectrics by laser and dc fields; VUV window failure by multiphoton absorption and electron defocusing, avalanche, and absorption; Optical distortion from the nonlinear refractive index; Studies of optical properties of alkali halide crystals; A possible mechanism for extrinsic absorption in insulators below the fundamental absorption edge; Multiphonon absorption of alkali halides and quasiselection rules; and enhanced stimulated raman scattering and general three-boson parametric instabilities. GRA

N76-17948# Washington Univ., Seattle. Dept. of Mining Metallurgical and Ceramic Engineering.
FABRICATION OF SPECIAL WAVEGUIDE SHAPES AND MECHANICAL PROPERTIES OF GLASS FIBER WAVEGUIDES Final Report on Task 4, 27 Nov. 1973 - 31 Dec. 1974
William D. Scott, G. Achutatamayya, Roger L. K. Matsumoto, and Gordon L. Mitchell 28 Feb. 1975 21 p ref
(Contract N00123-73-C-1200)
(AD-A016300) Avail: NTIS CSCL 20/6

Special optical fibers with exposed waveguides have been constructed for coupling between fibers and (integrated optics) films. They are typically 1 x 35 micrometers rectangular on a low index supporting structure which has a 200 x 1200

micrometer cross section. These externally mounted fibers were produced by pulling microscope slides of various material in a two step process. Measured coupling efficiencies between spuddered waveguides and externally mounted fibers are 70%. Transition fibers whose core cross section tapers from a rectangular (1 x 20 micrometers) to circular (3 micrometers) in a millimeter or two length have been produced for butt joining semiconductor lasers to round waveguides. They have measured transition losses of less than 1 dB and negligible absorption/scattering loss. GRA

N76-17949# Ohio State Univ., Columbus. Electroscience Lab.
COMPUTER SIMULATION OF RANDOM ATMOSPHERICALLY DEGRADED OPTICAL BEAMS Final Technical Report, 24 Jan. 1974 - 14 Jan. 1975
S. A. Collins, Jr. and D. D. Duncan Griffiss AFB, N. Y. RADC Sep. 1975 70 p refs
(Contract F30602-74-C-0130; DARPA Order 2646)
(AD-A016772; ESL-3862-2; RADC-TR-75-222) Avail: NTIS CSCL 20/6

This report develops a scheme for simulating randomly degraded optical beams including both phase and log-amplitude and the effect of their cross-correlation. The scheme works for optical degradations whose scale lengths range from much smaller to much larger than the input aperture size. An extension of the well-known Fourier transform method is used for the small scale fluctuations and a polynomial approach is used for the larger scale fluctuations. GRA

N76-17950# Harris Corp., Melbourne, Fla. Electronic Systems Div.
OPTICAL CABLE COMMUNICATIONS STUDY Final Report, 26 Mar. 1974 - 25 Apr. 1975
F. R. McDevitt and I. B. Slayton Jul. 1975 427 p refs
(Contract F30602-74-C-0193; AF Proj. 6523)
(AD-A016846; RADC-TR-75-187) Avail: NTIS CSCL 20/6

This study Final Report provides a general treatment of the design methodology for applying fiber optics technology to Air Force communications applications. The study was involved with the classification of the Air Force communications requirements which are suitable for optics implementation as well as the assessment of the rationale for applying fiber optics communications channels in contrast to the application of conventional cable alternatives. In parallel with this task, this study also involves the development of the analytical expressions for predicting system performance in terms of the design parameters associated with each of the constituent elements of a fiber optics link. Major elements being considered as part of this parameter translation and design methodology task include the application of coherent and noncoherent optical sources, acousto-optic and electro-optic modulators, step index graded index fibers, and PIN/Avalanche detectors. Communication alternatives considered include party line multiterminal and point-to-point communications involving both analog and digital baseband modulation as well as subcarrier intensity modulation. GRA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N76-17951* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SELF-ENERGIZED PLASMA COMPRESSOR Patent
Edward L. Shriver (NAS-NRC) and Eduard B. Igenbergs, inventors (to NASA) (NAS-NRC) Issued 30 Dec. 1975 4 p Filed 27 Aug. 1974 Supersedes N74-35145 (12 - 24, p 2983) Division of US Patent Appl. SN-367606, filed 6 Jun. 1973, US-Patent-3,854,097 Sponsored by NASA
(NASA-Case-MFS-22145-2; US-Patent-3,929,119; US-Patent-Appl-SN-500982; US-Patent-Class-124-1; US-Patent-Class-89-8; US-Patent-Class-124-11R; US-Patent-Appl-SN-367606; US-Patent-3,854,097) Avail: US Patent Office CSCL 20I

A self-energized plasma compressor which compresses plasma discharged from a coaxial plasma generator is described. The device includes a helically shaped coil which is coaxially aligned with the center axis of the coaxial plasma generator. The plasma generator creates a current through the helical coil which, in turn, generates a time varying magnetic field that creates a force which acts radially upon the plasma. The coaxial plasma generator and helical coil move the plasma under high pressure and temperature to the narrow end of the coil. Positioned adjacent the narrow end of the coil are beads which are engaged by the plasma to be accelerated to hypervelocities for simulating meteoroids. Official Gazette of the U.S. Patent Office

N76-17952 Wisconsin Univ., Madison.
NONLINEAR INTERACTIONS NEAR THE PLASMA RESONANCES Ph.D. Thesis
Vincent Sik-Hung Chan 1975 180 p
Avail: Univ. Microfilms Order No. 75-23836

The decay instabilities near the hybrid resonances in a homogeneous plasma in a uniform magnetostatic field are considered along with the case of an electron plasma with the extraordinary mode as the pump wave. Parametric instability is found to be more difficult to excite as compared to the case when the pump is an ordinary mode. The interaction was studied of two ordinary waves and an extraordinary wave through weak nonlinearity in a uniform, warm, electron plasma. The effects of collisions were taken into account by the inclusion of phenomenological collision frequencies. The nonlinear self-modulation of large amplitude waves was investigated. Using a singular perturbation procedure, a transport equation governing the slow variation of the wave amplitude for an ion plasma wave in a warm, unmagnetized plasma was obtained. Dissert. Abstr.

N76-17953*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A STRICTLY MARKOVIAN EXPANSION FOR PLASMA TURBULENCE THEORY
Frank C. Jones Jan. 1976 14 p refs Submitted for publication
(NASA-TM-X-71053; X-602-76-12) Avail: NTIS HC $3.50 CSCL 20I

The collision operator that appears in the equation of motion for a particle distribution function that was averaged over an ensemble of random Hamiltonians is non-Markovian. It is non-Markovian in that it involves a propagated integral over the past history of the ensemble averaged distribution function. All formal expansions of this nonlinear collision operator to date preserve this non-Markovian character term by term yielding an integro-differential equation that must be converted to a diffusion equation by an additional approximation. An expansion is derived for the collision operator that is strictly Markovian to any finite order and yields a diffusion equation as the lowest nontrivial order. The validity of this expansion is seen to be the same as that of the standard quasilinear expansion. Author

N76-17954# Oak Ridge National Lab., Tenn.
NEOCLASSICAL EQUILIBRIUM AND TRANSPORT CALCULATIONS FOR THE FULL RANGE OF COLLISIONALITY
C. O. Beasley, J. E. McCune, H. K. Meier, W. I. VanRij, and J. D. Callen 1975 4 p ref Presented at 7th European Conf. on Controlled Fusion and Plasma Physics, Lausanne, Switzerland, 1 Sep. 1975 Sponsored by ERDA
(Conf-750905-1) Avail: NTIS HC $4.00

The new Collisional Plasma Model, used to obtain neoclassical equilibria and transport in tori, is described. Results over the full collisionality range (banana through Pfirsch-Schluter) show the distribution function, radial flux, bootstrap current and other important macroscopic quantities, and are compared with earlier, more approximate results. Author (NSA)

N76-17955# Princeton Univ., N.J. Plasma Physics Lab.
MHD THEORY OF DIVERTORS WITHOUT VISCOSITY
A. H. Boozer Jul. 1975 32 p refs
(Contract AT(11-1)-3073)
(MATT-1149) Avail: NTIS HC $4.75

A simple model of a divertor was studied with the classical two-fluid MHD equations. The ion temperature is assumed zero, which has the simplifying effect of giving zero ion viscosity. The

electrons are shown to leave the divertor much closer to the main body of the plasma than the ions. The divertor width is found comparable to the ion gyroradius calculated with the electron temperature, which is substantially wider than some classical estimates. Author (NSA)

N76-17956#. California Univ., Livermore. Lawrence Livermore Lab.
COMPUTER APPLICATIONS IN CONTROLLED FUSION RESEARCH
J. Killeen Feb. 1975 23 p refs Presented at Natl. Topical Meeting of the ANS on Nuclear Engineering Educ., Univ. Park, Penn., 18 Aug. 1975 Sponsored by ERDA
(UCRL-76562; Conf-750808-1) Avail: NTIS HC $4.25

A recent study group identified five categories of computational models to study the physics of magnetically confined plasmas. A comparable number of types of models for engineering studies are called for. The development and application of computer codes to implement these models is a vital step in reaching the goal of fusion power. In order to meet the needs of the fusion program the National CTR Computer Center was established. A large central computing facility is linked to smaller computing centers at each of the major CTR laboratories by a communications network. The crucial element that is needed for success is trained personnel. The number of people with knowledge of plasma science and engineering that are trained in numerical methods and computer science is small, and must be increased. Nuclear engineering departments should encourage students to enter this field and provide the necessary courses and research programs in fusion computing. Author (NSA)

N76-17957# TRW Systems Group, Redondo Beach, Calif.
AN EXPERIMENTAL INVESTIGATION OF DENSE ION FLOW IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD Interim Report, 22 Feb. 1972 - 31 Mar. 1974
J. M. Sellen, Jr., H. S. Ogawa, and G. K. Komatsu 18 Jun. 1975 126 p refs
(Contract DNA001-72-C-0096)
(AD-A015385; DNA-3664Z) Avail: NTIS CSCL 20/9

The interaction of dense (10 to the 8th power-10 to the 10th power ions/cc) single and counterstreaming Cs(-) ion beams with a transverse magnetic field has been examined. Magnetic field strengths are in the range of 0-10 gauss, yielding electron radii of curvature small compared to beam diameter. Ion radii of curvature, from large ion mass and velocity is much greater than beam and testing chamber dimensions. Application of transverse fields above critical levels of about 3 gauss causes rapid increases in plasma potential turbulence for both single and counterstreaming beams. Heating of electrons is observed, and growth in ion density fluctuation is rapid for field levels greater than about 3 gauss. Ion transverse velocity build up in counterstreaming beam configurations appears in excess of single beam flow across the field, while ion density fluctuation build up in the single beams exceeds that of the counterstreaming flow. Wave growth for injected ion density waves has been examined as functions of injected wavelength, magnetic field strength, and wave traversal distance across the field. GRA

N76-17958# Technion, Inc., Irvine, Calif.
MECHANISMS OF MAGNETOPLASMADYNAMIC ARC JET ACCELERATION PROCESSES
Gordon L. Cann and Adriano Ducati 18 Aug. 1975 81 p refs
(Contract F44620-74-C-0017; AF Proj. 9752)
(AD-A015421; AFOSR-75-1397TR; ISR-2) Avail: NTIS CSCL 20/9

An extensive series of tests has been conducted in a large (10' x 20') vacuum chamber to investigate the feasibility of using the ambient air at a pressure level of 6 x 10 to the (-7) power to 10 to the (-4) power Torr as propellant in a Space Electric Ram Jet. During most of the tests, a low current discharge (.5 .05 amps) was used, however performance was also measured under pulsed (high current) conditions. Unambiguous time of flight measurements indicate an exhaust beam velocity of about 40,000 ma/sec under pulsed operation. Beam ion flux rates of up to several milliamperes per square meter were detected 14 ft from the engine when the discharge operated in the low current mode and probe measurements indicated that they had energies of close to 1000 volts (exhaust velocities about equal 100,000 m/sec). No erosion could be detected on the electrodes after more than 300 firings over a period of 3 days. GRA

N76-17959# Naval Research Lab., Washington, D.C.
A THEORY OF ANOMALOUS ENERGY FLUX AND DEPOSITION IN A LASER PRODUCED PLASMA Interim Report
Wallace M. Manheimer, Denis Colombant, and Robert Flynn Sep. 1975 34 p refs
(Contract AT(04-3)-878)
(AD-A015309; NRL-MR-3119) Avail: NTIS CSCL 20/9

If an unmagnetized plasma is collisionless, the heat flux is not equal to the thermal conduction coefficient times the temperature gradient. To study anomalous energy deposition in a collisionless plasma, the steady state fluid equations for the first four moments, density, velocity, temperature, and heat flux are examined. The fluid system is coupled to the system of equations for the unstable waves, and the interaction terms are written out as collision terms. The spatial dependence of fluid and wave quantities are solved numerically for the case where the anomalous absorption mechanism is the Compton sidescatter instability. Absorption efficiency can be as high as twenty percent, albeit for very long plasma lengths. GRA

N76-17960# Naval Research Lab., Washington, D.C.
THE ION INDUCED PINCH AND THE ENHANCEMENT OF ION CURRENT BY PINCHED ELECTRON FLOW IN RELATIVISTIC DIODES Interim Report
Shyke A. Goldstein and Roswell Lee Sep. 1975 16 p refs
(AD-A015275; NRL-MR-3124) Avail: NTIS CSCL 20/9

A new model for time dependent and steady state ion and electron flow in large aspect ratio diodes is constructed. The electron trajectories are computed using self consistent fields calculated during the initial ion motion. The dynamic formation of a tightly pinched electron flow is qualitatively explained. Very large ion currents, nearly equal to the electron current, are predicted for flat solid cathodes, when steady state flow is achieved. GRA

N76-17961# Naval Research Lab., Washington, D.C.
REFORMULATION OF THE PLASMA INVERSE SCATTERING PROBLEM
H. Harold Szu, C. E. Carroll, and Saeyoung Ahn Aug. 1975 14 p refs
(AD-A015303; NRL-MR-3108) Avail: NTIS CSCL 20/9

The one-dimensional problem of determining the density of a plasma from the reflection of electromagnetic waves has been solved by the Gel'Fand- Levitan technique. Here their integral equation is modified and simplified. Laplace transformation gives a simple functional equation, and the asymptotic for m of its solution yields the plasma density. GRA

N76-17962# Mission Research Corp., Santa Barbara, Calif.
A DERIVATION OF THE EQUATIONS OF COLLISIONLESS MAGNETOHYDRODYNAMICS Topical Report, Feb. - Dec. 1974
R. N. Wilson 18 Jun. 1975 71 p refs
(Contract DNA001-74-C-0212)
(AD-A015384; MRC-R-170; DNA-3642T) Avail: NTIS CSCL 20/9

Magnetohydrodynamic type equations are derived from the Boltzmann equation in the case where collision mean free paths are large compared to other characteristic lengths, (e.g., Larmor radii, hydrodynamic lengths, etc.) in the plasma. The Boltzmann distribution function is assumed to be isotropic in the components of the thermal velocity perpendicular to the local magnetic field. On the other hand, the distribution function is assumed to have a very general dependence on the velocity component (longitudinal velocity) parallel to the magnetic field. Accordingly, the longitudinal velocity coordinate is retained as an independent variable in the resulting 'collisionless magnetohydrodynamic equations'. The analysis presented in this report begins with a transformation theory of the Boltzmann equation and the resulting magnetohydrodynamic equations apply in the general case where there is no particular symmetry of the plasma or the electromagnetic field. In this sense, the analysis contained in this report is a generalization of that presented in a previous report which

assumed axisymmetry. Examples of problems for which the general formalism may find application are (1) the problem of high altitude nuclear explosions where non-axisymmetric effects are important and (2) fusion device plasmas in which geometries other than axisymmetric geometry are appropriate. GRA

N76-17963# Systems Science and Software, La Jolla, Calif.
CAPO USER'S GUIDE, VOLUME 1 Final Report
Ira Katz, Robert C. Vik, and James Harvey 18 Jun. 1975 233 p refs
(Contract DNA001-73-C-0061; DNA Proj. NWED-QAXP-C105)
(AD-A016672; SSS-R-74-2364-Vol-1; DNA-3600F-1) Avail: NTIS CSCL 20/13

This CAPO User's Guide serves as a complete reference manual on the concept, theory, and operation of the CAPO equation of state/opacity codes. Volume I contains program documentation. GRA

N76-17964# California Univ., Los Angeles. Plasma Physics Lab.
PARAMETRIC INSTABILITIES IN STRONGLY RELATIVISTIC, PLANE POLARIZED ELECTROMAGNETIC WAVES
J. F. Drake, Y. C. Lee, and N. L. Tsintsadze Sep. 1975 21 p refs
(Contracts N00014-75-C-0476-0001; AT(04-3)-34; Grant NSF GP-40983; NR Proj. 012-306)
(AD-A015328; PPG-238) Avail: NTIS CSCL 20/9

The authors investigate the stability of long wavelength, plane polarized electromagnetic waves when the oscillatory energy of the electrons exceeds their energy. The strong electron mass variation destabilizes electron modes polarized along the electric field of the pump (E sub 0). The electron and ion modes decouple in the presence of such an intense pump and hence the ions do not strongly influence the instability. GRA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

N76-17965+ Ecole Normale Superieure, Paris (France). Lab. de Physique des Solides.
INTERSTITIAL GOLD DIFFUSION IN SILICON
J. C. Bourgoin and J. K. OBrien [1974] 27 p refs
(Contract DGRST-73-7-1650)
Avail: NTIS HC $4.00

The study of gold diffusivity in silicon was extended in the temperature range 100 to 500 C, using capacitance-voltage measurements on gold-silicon Schottky diodes, in order to investigate the diffusion of interstitial gold atoms. The results obtained are in reasonable agreement with the interstitial controlled dissociative mechanism proposed by Wilcox and LaChapelle with the exception of the results corresponding to the lowest temperatures. The results are interpreted in terms of an 'ionization enhanced diffusion' mechanism in which the migration of an interstitial atom is caused by successive trapping of electrons and holes on its site. According to such a mechanism the activation for migration is related to the position of the electronic level associated to the interstitial in the forbidden gap and to the width of this gap. This mechanism provides a possible explanation for the relatively high diffusivity of interstitial gold atoms (and of other transition elements) as compared to other interstitial impurities whose ionic radii are smaller.
Author (ESA)

N76-17966+ Ecole Normale Superieure, Paris (France). Lab. de Physique des Solides.
IONIZATION ENHANCED DIFFUSION: DIODE DEGRADATION
J. K. OBrien, O. K. Griffith (State Univ. of New York, Albany), D. Lortigues, and J. C. Bourgoin [1974] 46 p refs
(Contract DGRST-73-7-1650)
Avail: NTIS HC $4.00

Gold-silicon Schottky diodes were subjected to forward bias for different current densities, at 300 and 150 K. The evolution of current voltage and capacitance-voltage characteristics vs treatment was studied. A progressive deterioration of the current-voltage characteristics, evolving from the characteristics of an abrupt junction to the characteristics of a resistance, was observed at both 300 and 150 K. Analysis of the evolution of the capacitance-voltage characteristics show that gold migrated into the space-charge region. The behavior, at 300 K, of the diffusion length of gold with the amount of injection provides evidence that this migration is due to certain diffusion mechanism caused by successive trapping of charged carriers. Author (ESA)

N76-17967+ Ecole Normale Superieure, Paris (France). Lab. de Physique des Solides.
DEFECT PRODUCTION IN SEMICONDUCTORS
J. C. Bourgoin [1974] 14 p refs
(Contract DGRST-73-7-1650)
Avail: NTIS HC $3.50

The different stages which cover the defect production are briefly described. Emphasis is placed on particular problems encountered in ion implantation, such as the nature of the damage in highly disordered regions and the influence of the ionization on the damage production. Electronic mechanisms which can play a role in defect production and annihilation are discussed.
Author (ESA)

N76-17968+ Radiotechniques S. A., Caen (France). Div. Industrielle et Technique.
RECOMBINATION OF EXCITONS IN ISOELECTRONIC CENTERS OF GaP AND GaPxAs(1-x)(x BETWEEN 0.5 AND 1) Final Report [ETUDE PHYSIQUE DES RECOMBINAISONS D'EXCITONS LIES A DES CENTRES ISOELECTRONIQUES DANS LE GaP ET LE GaPxALs(1-x)(x ENTRE 0,5 ET 1)]
D. Diguet, M. Gaffre, and J. Varon 26 Sep. 1974 49 p refs In FRENCH; ENGLISH summary
Avail: NTIS HC $4.00

Luminescence of isoelectronic nitrogen centers introduced into gallium phosphides and gallium phosphide arsenide Ga Px As (1-x) where x is greater than 0.5 was studied. Good electronic quality material was grown by epitaxy and doped-exciton link energy variation was studied as a function of composition and luminescence variation as a function of nitrogen content. ESA

N76-17969# California Univ., Davis. Dept. of Physics.
STUDY OF OPTICAL AND ELECTRONIC PROPERTIES OF SEMICONDUCTORS, SbSBr, SbSeI, AND SbSI Interim Report, 1 Oct. 1974 - 30 Jun. 1975
C. Y. Fong and F. O. Wooten 1975 10 p refs
(Grant AF-AFOSR-2353-72; AF Proj. 9763)
(AD-A015391; AFOSR-75-1391TR) Avail: NTIS CSCL 20/12

A preliminary energy band structure of SbSI obtained by empirical pseudopotential method is discussed with references to existing optical data and other calculations. Brief discussions on band structure results for niobium, of calculations on the angular-dependent photoemission from GaAs and charge distributions in transition metal compounds, TiC, TiN, ZrC, and ZrN are included. GRA

N76-17970# Florida Univ., Gainesville. Electron Device Research Center.
INVESTIGATION OF ELECTRONIC TRANSPORT, RECOMBINATION AND OPTICAL PROPERTIES IN InAs (1-x) P(x) Semiannual Technical Report, Dec. 1974 - May 1975
Sheng S. Li 15 Jun. 1975 73 p refs
(Contract DAAK02-74-C-0102; DARPA Order 2182)
(AD-A015605; SATR-3) Avail: NTIS CSCL 20/12

The research program sponsored by this contract during the fifth and sixth quarters has produced technical findings in several areas: (1) Electron microprobe analysis on fourteen InAs(1-x)P(x) epitaxial samples (of thicknesses ranging from 14.6 to 2.35 micrometers has yielded information in areas such as atomic compositions, the epitaxial layer homogeneity and the epilayer thickness. (2) Resistivity, Hall effect and magnetoresistance measurements on seven InAs(10.63)P(0.37) epitaxial samples have yielded information about both electron mobility and electron concentration as functions of the temperature and the H2 flow rate. (3) The optical absorption coefficient as a function

of wavelength, deduced from transmission measurements, is given for seven InAsP epitaxial samples. (4) The surface photovoltage (SPV) method for determining the minority carrier diffusion length, in both bulk and epitaxial semiconductor specimens, is described. GRA

N76-17971# Arizona Univ., Tucson. Optical Sciences Center.
MODULATION SPECTROSCOPY OF DISORDERED SOLIDS Final Report, 15 Jan. 1974 - 14 Jul. 1975
B. O. Seraphin Jul. 1975 77 p refs
(Grants DAHC04-74-G-0100; DA-ARO(D)-31-124-73-G1)
(AD-A015591; ARO-11086.3-P) Avail: NTIS CSCL 20/12

Modulation spectroscopy has been used to study disordered solids with a view toward using modulation spectroscopy to detect band edges in amorphous semiconductors. The Ge-Te binary alloy system was chosen for the study; samples spanned five different compositions. Thermoreflectance spectra were obtained which range from being rather featureless for the Ge-rich compositions to showing prominent structure (two negative peaks) for the Te-rich compositions. The peaks were correlated to the bonding and non-bonding electron states associated with the Te atoms. Work was done toward expressing the thermoreflectance in terms of the electronic structure. Attention was also given to the problem of interpreting the interference dominated spectra below the absorption edge. GRA

N76-17972# IBM Watson Research Center, Yorktown Heights, N.Y.
RELAXATION STUDIES OF THIN FILMS AND ION-IMPLANTED MATERIALS Final Report, 15 Apr. 1972 - 31 May 1975
B. S. Berry 27 Aug. 1975 13 p refs
(Contracts DAHC04-72-C-0026; DAHC04-75-C-0018)
(AD-A015595; ARO-10042.5-MC; ARO-13242.2-MS) Avail: NTIS CSCL 20/12

Internal friction measurements have been successfully employed for the first time to characterize defect-related phenomena in thin metallic films and implanted or irradiated silicon. The examples studied include interstitial impurity defects in niobium films, grain-boundary sliding in aluminum films, and point-defect damage in silicon. Three new defect centers have also been discovered in electron-irradiated silicon by EPR measurements. GRA

N76-17973# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
A COMPUTER PROGRAM FOR PLOTTING COORDINATION POLYHEDRA IN IONIC CRYSTALS-DRWMIN Environmental Research Papers
Rossman F. Giese, Jr. 24 Apr. 1975 30 p
(AF Proj. 8607)
(AD-A014788; AFCRL-TR-75-0234; AFCRL-ERP-508) Avail: NTIS CSCL 20/2

In recent years emphasis has been placed on interpreting the chemical and physical properties of crystals, and especially minerals, in terms of the arrangement of the atoms in the structure (or crystal structure). For example, most minerals, and especially silicate minerals, have complex structures which are difficult to understand without some sort of visual representation of the atomic positions in the unit cell. The crystal structure representations available in the literature are usually projections along standard or conventional directions, and may not be appropriate for special problems such as twinning or cleavage. The combination of digital computer with an on-line or off-line plotting facility offers a logical alternative. A computer program, DRWMIN, has been written. It is designed to draw projections of inorganic crystal structures. The structures, as drawn by the program, consist of coordination polyhedra of anions surrounding the cations. The projections may be along any direction (u v w) or onto the faces of the unit cell. GRA

N76-17974# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
AFCRL THERMAL IMAGING PROGRAM Physical Science Research Papers
John L. Sampson 6 Jun. 1975 15 p refs
(AF Proj. 5620)
(AD-A015044; AFCRL-TR-75-0322; AFCRL-PSRP-636) Avail: NTIS CSCL 20/2

The two thermal-imaging furnaces available at AFCRL for the growth of refractory crystals are described. A list is presented of crystals already grown in these furnaces, and of crystals which might be grown in them, with estimates of feasibility. GRA

N76-17975# California Univ., Los Angeles. Dept. of Physics.
RARE EARTH IONS IN CRYSTALLINE FIELDS Final Report, 1 Sep. 1964 - 30 Jun. 1974
Robert A. Satten Jul. 1975 14 p refs
(Grants DA-ARO(D)-31-124-71-G67;
DA-ARO(D)-31-124-G927)
(AD-A015565; ARO-2099; 42-P) Avail: NTIS CSCL 07/4

The research summarized in this report is basic research involving chiefly rare earth type ions (broadly defined to include ions with either unfilled 4f or 5f shells) in crystalline fields. The ion studied most often was U(-4). GRA

N76-17976# National Standard Reference Data System.
CRYSTAL STRUCTURE TRANSFORMERS IN INORGANIC NITRITES, NITRATES, AND CARBONATES
C. N. R. Rao, B. Prakash, and M. Natarajan May 1975 60 p refs
(COM-75-11437/1; NSRDS-NBS-53; LC-74-18389) Avail: NTIS HC $4.50 CSCL 07D

A critical survey of the data describing crystal structure transformations in inorganic nitrites, nitrates and carbonates is compiled. Data on crystallographic, thermodynamic, spectroscopic, electrical, dielectric and other properties are given for each solid. Experimental techniques used to obtain the data are given and comments on the data are included in the tables. The literature is surveyed up to June 1973. References were selected on the basis of their pertinence to the data cited. GRA

N76-17977# Sah (C. T.) Associates, Urbana, Ill.
EFFECTS OF IONIZING RADIATION ON THE CHARACTERISTICS OF METAL-OXIDE-SILICON STRUCTURES Final Report, 9 Aug. 1974 - 9 Mar. 1975
C. T. Sah and L. C. Sah Apr. 1975 56 p refs
(Contract DAAG39-75-C-0013)
(AD-A015292; SAHAS-75-1; HDL-CR-75-013-1) Avail: NTIS CSCL 20/12

The frequency and temperature dependences of the capacitance- and conductance-gate voltage characteristics of p-Si and n-Si MOS capacitors with high densities of process induced or KeV electron irradiation generated surface states and oxide charges are studied. The oxide charges are thought to originate from the interstitial oxygen donors while the surface states from trivalent silicon at the SiO2-Si interface. The room temperature radiation sensitivities of the Al-SiO2-Si system, under either positive or negative voltage applied to the aluminum electrode, are attributed to the high electric field drift of the OH(-) ions, which are freed from the trivalent silicon bonds, Si-OH, by the ionizing radiation. Fabrication conditions for producing the most radiation resistant SiO2-Si interface are proposed. GRA

N76-17978# Nebraska Univ., Lincoln. Behlen Physics Lab.
PRODUCTION OF SPONTANEOUS POLARIZATION BY ELASTIC INSTABILITIES IN PIEZOELECTRIC MATERIALS Final Scientific Report
John R. Hardy and Frank G. Ullman Jun. 1975 156 p refs
(Grant AF-AFOSR-1926-70; AF Proj. 9768)
(AD-A015184; AFOSR-75-1371TR) Avail: NTIS CSCL 20/12

This report consists of an introductory survey of the work carried out during the whole period of the Grant followed by a compilation of reprints or preprints of all journal articles that have been published, or submitted during this time. These cover the theoretical work on the lattice dynamics and stability of gadolinium molybdate and other structures and the experimental work on the pyroelectric properties, specific heat and Raman spectra of GMO. GRA

N76-17979# Intelcom Rad Tech, San Diego, Calif.
STUDY OF THE EFFECTS OF RADIATION ON THE ELECTRICAL AND OPTICAL PROPERTIES OF HgCdTe Final Report, 15 Apr. 1972 - 30 Apr. 1975
Charles E. Mallon, Barry A. Green, Roland E. Leadon, and James A. Naber 31 May 1975 113 p refs

(Contract F19628-72-C-0311; AF Proj. 5621)
(AD-A016756; RT-8027-019; AFCRL-TR-75-0310) Avail: NTIS CSCL 20/12

This report presents the results of experimental and theoretical investigations of the effects of electron, neutron, and gamma irradiations on the optical and electrical properties of the alloy semiconductor HgCdTe. The objective of the study is to obtain sufficient radiation effects data to enable prediction of the radiation response of infrared detector devices fabricated from HgCdTe. Section 2 discusses the results of a 14-MeV neutron irradiation at 80 K on n-type Hg(0.8)Cd(0.2)Te. The results of 80 K 5-MeV electron and fission neutron irradiations and isochronal anneal of p-type Hg(0.8)Cd(0.2)Te are discussed in Section 3. In Section 4 the results of various types of irradiations at 10 and 80 K are summarized and presented in terms of damage parameters that are then applied to HgCdTe photoconductive detectors to predict response degradation. Section 4 also includes a qualitative discussion of possible damage mechanisms in HgCdTe photovoltaic detectors. GRA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N76-17980 Illinois Univ., Chicago.
STATISTICAL THERMODYNAMIC APPROACH TO THE PREDICTION OF VAPOR-LIQUID EQUILIBRIUM PROPERTIES OF THE MIXTURES: HARD-SPHERE-EXPANSION TECHNIQUE Ph.D. Thesis
Shing-shong Lan 1975 162 p
Avail: Univ. Microfilms Order No. 76-2284

The thermodynamic properties of pure fluids, and excess thermodynamic and vapor-liquid equilibria properties of fluid mixtures were predicted. The equation of state of pure fluid employed was a result of the application of the perturbation theory which uses the hard-sphere fluid as the reference unperturbed system. Several improvements on this equation were made in order to calculate the properties of real fluids with enough accuracy. A Hard-Sphere-Expansion conformal solution theory was developed in order to predict multicomponent mixture properties. The results obtained compare quite favorably with the experimental values. The present approach, being a purely molecular theory of fluid mixtures, provides detailed insights into the peculiar behavior of the azeotropic fluid mixture. It is shown that the excess and vapor-liquid equilibria properties of multicomponent fluid systems can be predicted correctly through the statistical mechanics approach provided that alike - and unlike-interaction parameters of the species of the mixtures under consideration are known a priori. Dissert. Abstr.

N76-17981*# Scientific Translation Service, Santa Barbara, Calif.
ON ENTROPY REDUCTION IN A THERMODYNAMIC SYSTEM BY INTERFERENCE BY INTELLIGENT SUBJECTS
L. Szilard Washington NASA Feb. 1976 23 p refs Transl. into ENGLISH from Z. Phys. (West Germany), v. 53, 1929 p 840-856
(Contract NASw-2791)
(NASA-TT-F-16723) Avail: NTIS HC $3.50 CSCL 20M

A perpetual motion machine involving several types of molecules is discussed in which intelligent being influence the course of events. The recall property of the individual leads to a continuous increase in entropy. Author

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N76-17982*# Norfolk State Coll., Va.
A RESEARCH PROJECT TO DEVELOP AND EVALUATE A TECHNICAL EDUCATION COMPONENT ON MATERIALS TECHNOLOGY FOR ORIENTATION TO SPACE-AGE TECHNOLOGY Final Technical Report, 1 Jul. 1974 - 31 Jan. 1976
James A. Jacobs Jan. 1976 145 p refs
(Grant NsG-1073)
(NASA-CR-146414) Avail: NTIS HC $6.00 CSCL 05I

A project was initiated to develop, implement, and evaluate a prototype component for self-pacing, individualized instruction on basic materials science. Results of this project indicate that systematically developed, self-paced instruction provides an effective means for orienting nontraditional college students and secondary students, especially minorities, to both engineering technology and basic materials science. In addition, students using such a system gain greater chances for mastering subject matter than with conventional modes of instruction. Author

N76-17983*# George Washington Univ., Washington, D.C. Program of Policy Studies in Science and Technology.
THE EXPLORATION ETHIC: ITS HISTORICAL-INTELLECTUAL BASIS. OUTLOOK FOR SPACE (1980 - 2000)
Jerry Delli Priscoli and Milton Marney 2 Jun. 1975 24 p refs
(Contract NAS5-20843)
(NASA-CR-144729) Avail: NTIS HC $3.50 CSCL 05K

Principle components of the exploration ethic are discussed. Attempts were made to justify both the historical and intellectual aspects of the concept. It was noted that intellectual justification is strongly grounded on: (1) the complementarity of objective and normative inquiry as to method, and (2) interdisciplinary alliance of ethics of adaptive systems with contemporary decision sciences, as a theoretical basis. Historical exploration justification was associated with: (1) periods of civilization transition, (2) changes in the process of exploration which cause change in types of rationals used, sponsors involved, and explorers interest, and (3) the incorrectness of proven prior cost/benefit calculations. E.H.W.

N76-17984*# Hudson Inst., Inc., Croton-on-Hudson, N.Y.
IMPLICATIONS OF PUBLIC OPINION FOR SPACE PROGRAM PLANNING, 1980 - 2000 Final Report
William Overholt, Anthony J. Wiener, and Doris Yokelson 28 Jun. 1975 80 p refs
(Contract NAS5-20778)
(NASA-CR-144730; HI-2219/2-RR) Avail: NTIS HC $5.00 CSCL 05K

The effect of public opinion on future space programs is discussed in terms of direct support, apathy, or opposition, and concern about the tax burden, budgetary pressures, and national priorities. Factors considered include: the salience and visibility of NASA as compared with other issues, the sources of general pressure on the federal budget which could affect NASA, the public's opinions regarding the size and priority of NASA'S budget, the degree to which the executive can exercise leverage over NASA's budget through influencing or disregarding public opinion, the effects of linkages to other issues on space programs, and the public's general attitudes toward the progress of science. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research. .

N76-17985# Committee on Science and Technology (U. S. House).
NATIONAL SCIENCE FOUNDATION 1976 POSTURE HEARING
Washington GPO 1975 26 p Hearing before Comm. on Sci. and Technol., 94th Congr., 1st Sess., No. 8, 5 Feb. 1975
(GPO-48-153) Avail: NTIS Avail: Comm. on Sci. and

Technol.

Programs, plans, and budget of the National Science Foundation are discussed. Topics discussed include international cooperation in science, research projects, and social sciences. M.J.S.

N76-17986# Advisory Group for Aerospace Research and Development, Paris (France).

MEDICAL OFFICER CAREER MANAGEMENT AND RETENTION IN NATO ARMED FORCES: A WORKING GROUP REPORT

G. Zinnemann, ed. Dec. 1975 107 p refs

(AGARD-R-635) Avail: NTIS HC $5.50

The armed forces of most NATO nations experience great difficulty in attracting and retaining young medical officers unless a doctor draft, national service, or pay-back for their medical education makes a period of active military duty a legal requirement. Some of the disadvantages inherent in a military medical career vis-a-vis a civilian practice deter the average young doctor from choosing a career in military medicine voluntarily. Since the ever-present threat of a doctor shortage constitutes a problem of operational significance, the Working Group sought to: (1) define the factors of career motivation, (2) compare approaches, methods, and attempted solutions to the problem in participating countries, and (3) offer a set of recommendations designed to alleviate the situation. Author

N76-17987# Naval Postgraduate School, Monterey, Calif.

TECHNOLOGICAL FORECASTING AND MANAGEMENT ACTION M.S. Thesis

Abdolhosein Mojtehed Jabery Jun. 1975 103 p refs

(AD-A014631) Avail: NTIS CSCL 05/1

This thesis addresses the relationship between technological forecasting, technology assessment, and technology transfer, and presents the view points of authors in the subject areas. It indicates how technology originates, is planned for and finally transfers into ultimate use. Author (GRA)

N76-17988# Texas Univ., Austin. Center for Cybernetic Studies.

CONFIDENCE STRUCTURES IN DECISION MAKING

G. Leitmann and P. L. Yu Jun. 1975 32 p refs

(Contract N00014-75-C-0569; NR Proj. 047-021)

(AD-A015610; CCS-231) Avail: NTIS CSCL 12/2

Decision making is defined in terms of four elements: the set of decisions, the set of outcomes for each decision, a set-valued criterion function, the decision maker's value judgment for each outcome. Various confidence structures are defined, which give the decision maker's confidence of a given decision leading to a particular outcome. The relation of certain confidence structures to Bayesian decision making and to membership functions in fuzzy set theory is established. A number of schemes are discussed for arriving at 'best' decisions, and some new types of domination structures are introduced. GRA

N76-17989# Stanford Univ., Calif. Dept. of Engineering-Economic Systems.

FLEXIBILITY AND DECISION ANALYSIS Technical Report, 1 Apr. 1973 - 31 Apr. 1975

Miley Wesson Merkhofer 30 Jun. 1975 130 p refs

(Contract N00014-67-A-0112-0077; Grant NSF GK-36491; ARPA Order 2449; NR Proj. 197-024)

(AD-A015290; EES-DA-75-1) Avail: NTIS CSCL 05/1

The notion that a good decision strategy is a flexible one has long been intuitively appreciated by decision makers. Decision analysis, however, has had little to say on the subject of flexibility. The purpose of this thesis is to place the flexibility concept within the decision analysis framework. The analysis begins with an application of decision theory techniques to the problem of choosing between flexible and inflexible decision strategies. A precise mathematical definition of decision flexibility is proposed wherein the relative flexibility of a decision is measured by the size of the decision choice set. Further application of the theory of decision analysis provides a measure of the value of flexibility. GRA

N76-17990# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ORGANIZATION PROBLEMS IN THE DEVELOPMENT OF SCIENTIFIC AND TECHNICAL FORECASTING IN HUNGARY

L. Kishmarti and D. Parish 11 Feb. 1975 12 p Transl. into ENGLISH from the book "Sovet Ekon. Vzaimopomoschi. Postoiannaya Komissiya po Koordinatsii Nauchn. i Tekhn. Issled. Teoriya i Praktika Prognozirovaniya Razvitiya nauki i Tekhn. v Stranakh-Chlenakh Sev" Moscow, 1971 p 153-156

(AD-A007401; FTD-HC-23-2348-74) Avail: NTIS CSCL 05/1

A methodology for scientific and technical forecasting in Hungary is developed. Forecasts are worked out to evaluate expected world events and the influence of probable events on Hungarian science, technology, and economics is evaluated. This approach is also used to determine concepts of scientific and technical development. Author

N76-17991# Stanford Univ., Calif. Dept. of Engineering-Economic Systems.

THE VALUE OF INFORMATION GIVEN DECISION FLEXIBILITY Technical Report, 1 May 1973 - 31 May 1975

Miley Wesson Merkhofer 30 Jun. 1975 30 p refs

(Contract N00014-67-A-0112-0077; Grant NSF GK-36491; ARPA Order 2449)

(AD-A016836; ESS-DA-75-2) Avail: NTIS CSCL 12/2

This paper presents a useful concept for decision analysis -- the value of information having flexibility. An exploration is made into the impact of decision flexibility on the value of information. The usefulness of calculating the value of information under various assumptions concerning decision flexibility is illustrated with a simple economic example. An upper limit to the value of information given flexibility is the expected value of perfect information given perfect flexibility (EVPIGPF). By approximating an arbitrary smooth value function with a quadratic equation, first order characteristics of the EVPIGPF are identified. Finally, it is shown that the technique of proximal decision analysis may be expanded to provide a simplified estimation of the EVPIGPF for large-scale decision problems. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software.*

N76-17992* National Aeronautics and Space Administration, Washington, D.C.

NASA THESAURUS. VOLUME 1: ALPHABETICAL LISTING 1976 Edition

Jan. 1976 820 p

(NASA-SP-7050-Vol-1) Avail: NTIS HC $15.00 CSCL 05B

The NASA Thesaurus -- Volume 1, Alphabetical Listing -- contains all subject terms (postable and nonpostable) approved for use in the NASA scientific and technical information system. Included are the subject terms of the Preliminary Edition of the NASA Thesaurus (NASA SP-7030, December 1967); of the NASA Thesaurus Alphabetical Update (NASA SP-7040, September 1971); and terms approved, added or changed through May 31, 1975. Thesaurus structuring, including scope notes, a generic structure with broader-term/narrower-term (BT-NT) relationships displayed in embedded hierarchies, and other cross references, is provided for each term, as appropriate. Author

N76-17993* National Aeronautics and Space Administration, Washington, D.C.

NASA THESAURUS. VOLUME 2: ACCESS VOCABULARY 1976 Edition

Jan. 1976 442 p

(NASA-SP-7050-Vol-2) Avail: NTIS HC $8.50 CSCL 05B

The NASA Thesaurus -- Volume 2, Access Vocabulary -- contains an alphabetical listing of all Thesaurus terms (postable and nonpostable) and permutations of all multiword and pseudo-multiword terms. Also included are Other Words (non-Thesaurus terms) consisting of abbreviations, chemical

symbols, etc. The permutations and Other Words provide 'access' to the appropriate postable entries in the Thesaurus. Author

N76-17994# Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
Apr. 1975 87 p refs
(PB-244559/1) Avail: NTIS HC $5.00; Also available from NTIS on subscription $40.00/year domestic, $50.00/year foreign CSCL 05B

The following topics are discussed: The skylab/ATM experiments of NRL-historical, operational, and results; Progress notes-acoustics; Chemistry; Communications sciences; Electronics technology; Engineering materials; Material sciences; Ocean sciences; Optical materials; Radar; Radiation technology; Sonar; Space science; Papers by NRL staff members; Patents; and Reader service. GRA

N76-17995# Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
May 1975 59 p refs
(PB-244994/0) Avail: NTIS HC $4.50; Also available from NTIS on subscription $40.00/year domestic, $50.00/year foreign CSCL 05B

Properties of superconducting Pd-H alloys; Progress notes - acoustics, communications sciences, electronics technology, engineering materials, material sciences, radiation technology, sonar, space systems; Papers by NRL staff members; Patents; and Reader service. GRA

N76-17996# Transportation Research Board, Washington, D.C.
DESIGN CONCEPTS FOR A NATIONAL NETWORK OF TRANSPORTATION RESEARCH INFORMATION SERVICES (TRISNET) Final Report, Jul. 1974 - Jul. 1975
Jul. 1975 86 p
(Contract DOT-OS-40022)
(PB-245311/6; DOT-TST-76-30) Avail: NTIS HC $5.00 CSCL 05B

A coordinated network of libraries, document repositories, abstracting and indexing services and other types of information centers (TRISNET) that provide information services to users of transportation research information is discussed. The purpose of TRISNET is to provide optimum access to needed information through the cooperative efforts of existing services and new services that are needed for completing the network. Expected benefits to users include easier and more economic access to the full range of transportation, research information via TRISNET services and products, and faster and more reliable response to inquiries and requests. GRA

N76-17997# Battelle Columbus Labs., Ohio.
A CRITICAL REVIEW OF RESEARCH RELATED TO THE ECONOMICS OF THE SCIENTIFIC AND TECHNICAL INFORMATION INDUSTRY Final Report, Apr. 1974 - Mar. 1975
George W. Tressel and Patricia L. Brown 25 Mar. 1975 64 p refs
(Grant NSF SIS-74-10449-A01)
(PB-245665/5) Avail: NTIS HC $4.50 CSCL 05B

The critical issues and open questions relating to the economics of the scientific and technical information industry are discussed. There is hardly an area that does not call for more and better research -- yet the need is not nearly so much for quantity as for a more coherent and meaningful pattern. Development of such a pattern depends to a large extent upon a body of fundamental information about the field itself. A broad effort to collect available data is recommended, together with development of standarized collection methodologies which can meet critical scrutiny as well as provide the necessary additional comparative and additive information. A strong need for increased research and policy study of the roles and processes of information diffusion into the private sector is stressed. GRA

N76-17998# California Univ., Irvine. Urban Information Systems Research Group.
MUNICIPAL INFORMATION SYSTEMS: EVALUATION OF POLICY RELATED RESEARCH. VOLUME 1: SUMMARY OF RESEARCH FINDINGS FOR POLICY MAKERS Final Report
Kenneth L. Kraemer and John Leslie King Aug. 1975 138 p refs
(Grant NSF GI-39068)
(PB-245687/9; NSF/RA/S-74-037) Avail: NTIS HC $6.00 CSCL 13B

The findings of an evaluation of policy research in information systems are summarized. The purpose of the EPRIS project was to collect and study all the available research on information systems that might be helpful to local government executives, including mayors, city managers, county chairman, county executives, and city and county department heads. In addition, the work was directed toward the needs of staff who support executive decision makers, toward data processing personnel, and toward those who set policy for funding local government data processing development. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N76-17999# Joint Economic Committee (U. S. Congress).
THE 1975 ECONOMIC REPORT OF THE PRESIDENT, PART 2
Washington GPO 1975 297 p refs Hearings before Joint Economic Comm., 94th Congr., 1st Sess., 5-7 Feb. and 14 Feb. 1975
(GPO-53-524) Avail: SOD HC $2.70

The President's budget statement and economic statement of 1975 is discussed. Topics considered include: unemployment; economic stimulation of the private sector vs increased government spending; tax reductions; gasoline taxes; labor/management relations; inflation vs recession; and economic growth. J.M.S.

N76-18000# Joint Economic Committee (U. S. Congress).
THE ECONOMIC IMPACT OF ENVIRONMENTAL REGULATIONS
Washington GPO 1974 230 p refs Hearings pursuant to S. Con. Res. 93 before Joint Economic Comm., 93d Congr., 2d Sess., 19, 21-22 Nov. 1974
(GPO-51-795) Avail: SOD HC $2.15

The costs and benefits of energy conservation and environmental regulations are discussed in terms of strengthening, maintaining, or relaxing the present standards. Factors considered include: inflationary and recessionary effects; impact of environmental regulations on domestic energy resources; environmental damage caused by the development of energy fuels; effect of pollution control regulations on energy fuel development and the consumption of energy; interaction of environmental regulations with the development of western coal, offshore oil, and nuclear energy; and the relationship of energy conservation, pollution control, and increased quality of economic growth. J.M.S.

N76-18001# Army Air Mobility Research and Development Lab., Fort Eustis, Va.
ARMY HELICOPTER COST DRIVERS
Harold K. Reddick, Jr. Aug. 1975 39 p refs
(DA Proj. 1f2-62209-AH-76)
(AD-A015517; USAAMRDL-TM-7) Avail: NTIS CSCL 01/3

The objective of this investigation is to identify the major high-cost areas, referred to as 'cost drivers', for Army helicopters. The helicopter life-cycle cost is divided into two major areas-acquisition and operating-for breakdown and examination. Acquisition costs, which include R and D and production, generally account for 25 percent of the life-cycle cost. The operating costs, which account for the remaining 75 percent, are examined in terms of maintenance and parts, personnel, and consumables. The helicopter is divided into major subassemblies such as rotor, transmission, and airframe, and each is examined in detail. GRA

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

N76-18002# Committee on Science and Technology (U. S. House).
AUTHORIZING APPROPRIATIONS TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington GPO 14 Mar. 1974 185 p Rept. to accompany H.R. 4700, 94th Congr., 1st Sess., 14 Mar. 1974
(H-Rept-94-63) Avail: US Capitol, House Document Room

Appropriations are discussed for research and development, construction of facilities, and research and program management. Research and development in the following areas are discussed: space shuttles, space flight operations, advanced missions, physics and astronomy, lunar and planetary exploration, launch vehicle procurement, space applications, aeronautical research and technology, space and nuclear research, energy technology applications, and tracking and data acquisition. The construction is discussed of transonic wind tunnels, space shuttle facilities, and subsonic tunnels. M.J.S.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N76-18003# Transportation Systems Center, Cambridge, Mass.
A COMPARISON OF METHODS FOR EVALUATING URBAN TRANSPORTATION ALTERNATIVES Final Report
Leonard Bronitsky and Joseph Misner Feb. 1975 62 p refs
(PB-245312/4; DOT-TSC-UMTA-75-5;
UMTA-MA-06-0053-74-1) Avail: NTIS HC $4.50 CSCL 13B

Alternative methods were compared for evaluating urban transportation improvement options. Each method was assessed within the framework of eight methodological criteria relating to the three major concerns of feasibility, reviewability, and relevancy. The following conclusions are drawn: (1) the judgmental method is satisfactory in several respects, but its subjectivity, lack of specificity might create difficulties in a federal review of the local decision process; (2) of the systematic evaluation methods, cost-effectiveness analysis based on multiple measures of effectiveness poses the fewest difficulties in simultaneously serving the local and federal purposes. GRA

88 SPACE SCIENCES (GENERAL)

N76-18004*# National Aeronautics and Space Administration, Washington, D.C.
OUTLOOK FOR SPACE Report to the NASA Administrator by the Outlook for Space Study Group
Jan. 1976 373 p refs
(NASA-SP-386) Avail: NTIS MF $2.25; SOD HC $4.40 CSCL 22A

Future space activities within the context of national needs were examined, and directions that the United States should take in the civilian use and exploration of space for the time period from 1980 to 2000 were identified. It was decided that the following activities should be pursued: (1) those related to the continuing struggle to improve the quality of life (food production and distribution, new energy sources, etc., (2) those meeting the need for intellectual challenge, for exploration, and for the knowledge by which man can better understand the universe and his relationship to it, (3) those related to research and development in areas applicable to future space systems and missions. A continuing emphasis should be placed on orienting the space program to the physical needs of mankind, to the quest of the mind and spirit, to the vitality of the nation and to the relationship between this nation and other nations of the world. Y.J.A.

N76-18005*# National Aeronautics and Space Administration, Washington, D.C.
A FORECAST OF SPACE TECHNOLOGY, 1980 - 2000
Jan. 1976 320 p refs
(NASA-SP-387) Avail: NTIS MF $2.25; SOD HC $4.00 CSCL 22A

The future of space technology in the United States during the period 1980-2000 was presented, in relation to its overall role within the space program. Conclusions were drawn and certain critical areas were identified. Three different methods to support this work were discussed: (1) by industry, largely without NASA or other government support, (2) partially by industry, but requiring a fraction of NASA or similar government support, (3) currently unique to space requirements and therefore relying almost totally on NASA support. The proposed work was divided into the following areas: (1) management of information (acquisition, transfer, processing, storing) (2) management of energy (earth-to-orbit operations, space power and propulsion), (3) management of matter (animate, inanimate, transfer, storage), (4) basic scientific resources for technological advancement (cryogenics, superconductivity, microstructures, coherent radiation and integrated optics technology). Y.J.A.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N76-18006*# Arizona Univ., Tucson.
IMAGE DISSECTOR CONTROL AND DATA SYSTEM ELECTRONICS, PART 1, PART 2, AND PART 3 Final Technical Report
15 Dec. 1975 528 p
(Grant NGR-03-002-032)
(NASA-CR-146360; A-75-10-ABC-Pt-1; A-75-10-ABC-Pt-2; A-75-10-ABC-Pt-3) Avail: NTIS HC $13.00 CSCL 03A

The operating and calibration procedures, design details, and maintenance information for the control console and the associated electronics are presented. Detailed circuit connector information is included which describes the destination of each wire leaving each pin of each circuit board. The schematic diagrams of the circuit boards in the system and of the interconnection between boards and consoles are presented. Author

N76-18007*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A REDUCED STAR CATALOG CONTAINING 5116 DESIGNATED STARS
Jack W. Rhoads 15 Jan. 1976 335 p refs
(Contract NAS7-100)
(NASA-CR-145823; JPL-TM-33-758) Avail: NTIS HC $10.00 CSCL 03A

Positional and color magnitude data for 5116 stars are given. Author

N76-18008*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
IRON LINE EMISSION FROM A HIGH TEMPERATURE PLASMA IN Cas A
S. H. Pravdo (Md. Univ., College Park), R. H. Becker, E. A. Boldt, S. S. Holt, R. E. Rothschild, P. J. Serlemitsos, and J. H. Swank Jan. 1976 16 p refs Submitted for publication
(Grant NGR-21-002-316)
(NASA-TM-X-71064; X-661-76-8) Avail: NTIS HC $3.50 CSCL 03A

The X-ray spectrum of Cassiopeia A was observed for several days by the proportional counter experiment on board OSO-8. The high energy (> 5 keV) data are fit well by a thermal spectrum. A narrow iron line which is predicted by the thermal model is also observed. The low energy (2-5 keV) data show an excess

over the high temperature component which is consistent with the presence of an additional low temperature thermal component. Iron abundance in the source relative to normal cosmic abundance is discussed, as in the relation of this observation to shock wave and multi-component thermal models for supernova remnants. Author

N76-18009*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STATISTICAL EQUILIBRIUM CALCULATIONS FOR SILICON IN EARLY-TYPE MODEL STELLAR ATMOSPHERES
Lucas W. Kamp Washington Feb. 1976 158 p refs
(NASA-TR-R-455; G-7569) Avail: NTIS HC $6.75 CSCL 03A

Line profiles of 36 multiplets of silicon (Si) II, III, and IV were computed for a grid of model atmospheres covering the range from 15,000 to 35,000 K in effective temperature and 2.5 to 4.5 in log (gravity). The computations involved simultaneous solution of the steady-state statistical equilibrium equations for the populations and of the equation of radiative transfer in the lines. The variables were linearized, and successive corrections were computed until a minimal accuracy of 1/1000 in the line intensities was reached. The common assumption of local thermodynamic equilibrium (LTE) was dropped. The model atmospheres used also were computed by non-LTE methods. Some effects that were incorporated into the calculations were the depression of the continuum by free electrons, hydrogen and ionized helium line blocking, and auto-ionization and dielectronic recombination, which later were found to be insignificant: Use of radiation damping and detailed electron (quadratic Stark) damping constants had small but significant effects on the strong resonance lines of Si III and IV. For weak and intermediate-strength lines, large differences with respect to LTE computations, the results of which are also presented, were found in line shapes and strengths. For the strong lines the differences are generally small, except for the models at the hot, low-gravity extreme of our range. These computations should be useful in the interpretation of the spectra of stars in the spectral range B0-B5, luminosity classes III, IV, and V. Author

N76-18010# Owens Valley Radio Observatory, Pasadena, Calif.
VLBI OBSERVATIONS OF THE COMPACT RADIO SOURCE IN THE CENTER OF THE GALAXY
K. Y. Lo, R. T. Schilizzi, M. H. Cohen, and H. N. Ross 1975 14 p refs
(Contract N00014-67-A-0094-0019)
(AD-A015298; Rept-1975-16) Avail: NTIS CSCL 03/2

The detection of a compact radio source in the direction of the Galactic Center during VLBI observations at 3.7 cm on 19 May, 1975 between the Owens Valley Radio Observatory 40-m telescope and the Goldstone 64-m telescope is reported. The recording of the signals and the subsequent cross-correlation were made with the standard MkII VLBI system with a bandwidth of 2 MHz. GRA

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N76-18011*# Scientific Translation Service, Santa Barbara, Calif.
TIDAL FRICTION IN THE TWO BODY PROBLEM
Horst Gerstenkorn Washington NASA Feb. 1976 45 p refs Transl. into ENGLISH from Z. Astrophys. (West Germany), v. 36, 1955 p 245-274
(Contract NASw-2483)
(NASA-TT-F-16722) Avail: NTIS HC $4.00 CSCL 03B

The two-body problem with elliptical orbits and weak tidal friction on one of the bodies (earth) is discussed, and the analysis of Darwin is continued. The influence of the sun is also considered, and hypotheses are established regarding the origin and development of the earth-moon system. Author

N76-18012*# Kanner (Leo) Associates, Redwood City, Calif.
A MODEL OF THE EJECTION OF MATTER FROM NOVAE
I. Malakpur Washington NASA Feb. 1976 28 p refs Transl. into ENGLISH from Astrophys. Space Sci. (France), v. 27, 1974 p 467-484
(Contract NASw-2481)
(NASA-TT-F-16714) Avail: NTIS HC $4.00 CSCL 03B

It was found that the gas of the premaximum, diffuse-enhanced and orion systems is produced by the nova itself and is ejected by shock waves in the form of discrete layers. The principal envelope originates in the gas responsible for the premaximum system, as a result of considerable, sudden increase of the radiation pressure of L alpha a certain time after the beginning of the nova explosion. The radiation pressure accelerates a part of the premaximum envelope and it is this accelerated part of the premaximum envelope that forms the principal envelope of nova. This acceleration is then transferred to the outer regions of the envelope. The mass of the principal envelope therefore increases continuously. Author

N76-18013*# Kanner (Leo) Associates, Redwood City, Calif.
INTERPRETATION OF MEASUREMENTS OF THE RADIAL VELOCITY OF PULSARS
Jacqueline Duquesne and Evry Schatzman Washington NASA Feb. 1976 20 p refs Transl. into ENGLISH from Ann. Astrophys. (France), v. 18, no. 4, 1955 p 279-291
(Contract NASw-2481)
(NASA-TT-F-16708) Avail: NTIS HC $3.50 CSCL 03B

Measurement of the radial velocity of pulsars is based on the average velocity of matter over the entire surface of the star. For this investigation, the measured spectra were assumed to be relatively dispersed in order to assume that measurement of the radial velocity may be based on measurement of the position of the base of the lines. The relationship between the ratio of the measured radial velocity u to the motion of the center of the pulsar and the speed of the matter w,w = psi u was established; this equation varies with the phase. Application of this theory to eta Aquilae was studied and a new curve for variations in the spectroscopic radius with the phase was derived. Comparison with variations in the photometric radius obtained by Pecker and Cannavaggia led to an analysis of the shape parameter and an estimate of the radius of the pulsar. Author

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N76-18014*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REQUIREMENTS AND CAPABILITIES FOR PLANETARY MISSIONS: MARINER ENCKE BALLISTIC FLYBY 1980
G. G. Ball and T. H. Bird Nov. 1975 13 p refs
(Contract NAS7-100)
(NASA-CR-145727; JPL-SP-43-27-Vol-1) Avail: NTIS HC $3.50 CSCL 03B

This mission will provide a broad-based fast reconnaissance of comet Encke, building a data base for subsequent more detailed comet investigations, including rendezvous. After a 3 month flight, the spacecraft will encounter the comet at a nominal range of about 500 km. Flyby velocity will be 7 to 28 km/sec depending on choice of arrival data (0 to 35 days before Encke perihelion) and launch vehicle. The spacecraft will be similar to the MVM 73 spacecraft, with scan platform and 117 kbps encounter data rate, and designed to survive the thermal environment of 0.34 to 0.8 AU. Author

N76-18015*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
MARS-5 INTENSITY AND SPECTRAL COMPOSITION MEASUREMENTS OF MARTIAN GAMMA-RADIATION
A. P. Vinogradov, Yu. A. Surkov, L. P. Moskaleva, and F. F. Kirnozov Washington NASA Jan. 1976 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 223, no. 6, 21 Aug. 1975 p 1336-1339
(Contract NASw-2789)

(NASA-TT-F-16850) Avail: NTIS HC $3.50 CSCL 03B

The Mars-5 automatic interplanetary station (AIS) was equipped with a gamma-spectrometer containing a scintillation detector and a 256-channel pulse-amplitude analyzer. Some gamma-spectroscopic measurements were conducted during the interplanetary (Earth-Mars) flight at 612., 85.4, and 93.8 million km from earth. Martian measurements were conducted from the orbiting Mars-5 AIS in 60 min sessions at an average altitude about 2300 km. Portions of trajectories when the gamma spectrometer was operating are shown as traces on a Martian map. They all are located from -50 deg to +25 deg and from 170 deg W to 320 deg E. Preliminary analysis of experimental data was conducted to determine the contribution of natural radioisotopes, since data on the content of uranium throrium and potassium are considered important geochemical information. Author

N76-18016*# Agnew Tech-Tran, Inc., Woodland Hills, Calif.
STRUCTURE AND DYNAMICS OF THE VENUS THERMOSPHERE
M. N. Izakov and S. K. Morozov Washington NASA Jan. 1976 23 p refs Transl. into ENGLISH from Kosm. Issled. (USSR), v. 13, no. 3, May-Jun. 1975 p 404-414
(Contract NASw-2789)
(NASA-TT-F-16849) HC $3.50 CSCL 03B

A theoretical model of the Venus thermosphere is constructed. For this purpose, the thermosphere is considered a continuous medium, and the system of gas-dynamics equations in the Navier-Stokes form is used for its description. Two variants of the model considered differ by: neglecting the rotation of the Venus mesosphere, and taking into account the mesosphere rotation with a period equal to four earth days in the direction of the Venus rotation. It is shown that absorption of solar radiation on the daylight side cause global circulation with vertical motions upward on the daylight side and downward on the night side. The temperature is distributed with a great difference between temperatures of the upper atmosphere on the daylight and night sides of the planet. Calculated and experimentally obtained temperatures coincide well, indicating that the level of solar activity accepted for calculations is sufficient for the observed heating of the thermosphere. Author

N76-18017*# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
A PROGRAM OF DATA SYNTHESIS FROM THE ALSEP/CPLEE ALSEP/SIDE, AND EXPLORER 35 MAGNETOMETER TO INVESTIGATE LUNAR TERMINATOR AND NIGHTSIDE PARTICLE FLUXES AND SURFACE INTERACTIONS Final Technical Report
David L. Reasoner 2 Feb. 1976 73 p refs
(Grant NsG-07025)
(NASA-CR-146413) Avail: NTIS HC $4.50 CSCL 03B

Lunar nightside electron fluxes were studied with the aid of the ALSEP/CPLEE and other instruments. The flux events were shown to be due to (a) electrons propagating upstream from the earth's bow shock, (b) electrons thermalized and scattered to the lunar surface by disturbances along the boundary of the lunar solarwind cavity, and (c) solar wind electrons scattered to the lunar surface by lunar limb shocks and/or compressional disturbances. These electrons were identified as a cause of the high night surface negative potentials observed in tha ALSEP/SIDE ion data. A study was also made of the shadowing of magnetotail plasma sheet electrons by interactions between the lunar body and the ambient magnetic field and by interactions between charged particles and lunar remnant magnetic fields. These shadowing effects were shown to modify lunar surface and near-lunar potential distributions. Author

N76-18018*# Rockwell International Corp., Thousand Oaks, Calif. Science Center.
LUNAR SAMPLE ANALYSIS Annual Report
B. R. Tittmann 31 Jan. 1976 7 p refs
(Contract NAS9-13846)
(NASA-CR-147449; SC577.25AR; AR-2) Avail: NTIS HC $3.50 CSCL 03B

Room temperature internal friction (Q sup-1) values of the 0.00002-0.00003 range were achieved with lunar rock 70215,85 by thorough outgassing procedures in ultrahigh vacuum. Results are presented on the temperature dependence of Q sup -1 as measured in the range 25 C to 600 C along with some data on the change in Q sup -1 with pressure in ultrahigh vacuum. The temperature dependence shows the existence of an internal friction peak at around 200 C followed at high temperatures by an extensive region with flat Q sup -1 (approximately 0.001); the work at ultrahigh vacuum shows decreases in the internal friction with decreases in ambient pressure even in the range 10 to the -8 to 10 to the -10 power torr. Author

N76-18019*# Scientific Translation Service, Santa Barbara, Calif.
A HYPOTHESIS ON THE ORIGIN OF SATURN'S RINGS
Vittorio Banfi Washington NASA Feb. 1976 24 p refs Transl. into ENGLISH from Soc. Astron. Ital., Mem. (Italy), v. 53, Apr. - Jun. 1972 p 247-262
(NASA-TT-F-16713) Avail: NTIS HC $3.50 CSCL 03B

A hypothesis on Saturn ring formation is presented. Instead of assuming a mechanical basic process, the formation is explained as a consequence of an electromagnetic phenomenon. It is suggested that, during solar system formation, in the outer parts of Saturn's protoatmosphere, there was a conspicuous escape of gas molecules having large kinetic energy. Successive ionization (by X, gamma, and cosmic radiation) took place and then the magnetic field of Saturn caused a capture and an electrocombination of particles. The mechanism is described in mathematical terms. The final result is the arrangement of pieces of ice in the equatorial plane - in stable mechanical equilibrium forming Saturnian rings. Author

N76-18020*# Kanner (Leo) Associates, Redwood City, Calif.
OBSERVATIONS CONCERNING THE PHYSICAL NATURE OF HALLEY'S COMET AND RESULTANT COMMENTS
F. W. Bessel Washington NASA Feb. 1976 65 p ref Transl. into ENGLISH from Astron. Nachr. (East Germany), v. 13, no. 300, 301, and 302, 1836 p 185-232
(Contract NASw-2481)
(NASA-TT-F-16726) Avail: NTIS HC $4.50 CSCL 03B

Observed characteristics of Halley's Comet itself are described as a sequel to reported characteristics of its motion. A wedge of material emanating in the general direction of the sun appears to oscillate about an axis toward the sun. Two hypotheses designed to explain the behavior of material leaving the nucleus of the comet are discussed: the existence of an ether whose density relative to that of comet particles determines their behavior, and the existence of a (polar) force different from the sun's normal gravitational attraction. The behavior of Halley's Comet and several others appears to favor the latter hypothesis. Author

N76-18021*# California Inst. of Tech., Pasadena.
MARINER 6 AND 7 PICTURE ANALYSIS Final Technical Report
Robert B. Leighton [1975] 18 p
(Grant NGR-05-002-181)
(NASA-CR-146382) Avail: NTIS HC $3.50 CSCL 03B

Analysis of Mariner 6 and 7 far-encounter (FE) pictures is discussed. The purpose of the studies was to devise ways to combine digital data from the full set of FE pictures so as to improve surface resolution, distinguish clouds and haze patches from permanent surface topographic markings, deduce improved values for radius, oblateness, and spin-axis orientation, and produce a composite photographic map of Mars. Attempts to measure and correct camera distortions, locate each image in the frame, and convert image coordinates to martian surface coordinates were highly successful; residual uncertainties in location were considerably less than one pixel. However, analysis of the data to improve the radius, figure, and axial tilt and to produce a composite map was curtailed because of the superior data provided by Mariner 9. The data, programs, and intermediate results are still available (1976), and the project could be resumed with little difficulty. Author

N76-18022*# Defense Mapping Agency Aerospace Center, St. Louis, Mo.
LUNAR CARTOGRAPHIC DOSSIER, VOLUME 1
Lawrence A. Schimerman, ed. Feb. 1975 221 p refs Sponsored by NASA Original contains color illustrations
(NASA-CR-146400) Avail: NTIS HC $7.75 CSCL 03B

The dossier is designed to provide an up to date summary of the extent and quality of cartographic information as well as

describing materials available to support lunar scientific investigation and study. It covers the specific photographic, selenodetic and cartographic data considered to be of continuing significance to users of lunar cartographic information. Historical background data is included. Descriptive and evaluative information is presented concerning lunar maps, photomaps and photo mosaics. Discussion comprises identification of series or individual sheet characteristics, control basis, source materials and compilation methodology used. The global, regional and local selenodetic control are described which were produced for lunar feature location in support of lunar mapping or positional study. Further discussion covers the fundamental basis for each control system, number of points produced, techniques employed and evaluated accuracy. Although lunar photography is an informational source rather than a cartographic product, a photography section was included to facilitate correlation to the mapping and control works described. Description of lunar photographic systems, photography and photo support data are presented from a cartographic-photogrammetric viewpoint with commentary on cartographic applications. Author

N76-18023*# Science Applications, Inc., Rolling Meadows, Ill.
ERROR ANALYSIS OF PENETRATOR IMPACTS ON BODIES WITHOUT ATMOSPHERES
Donald R. Davis Feb. 1975 70 p refs
(Contract NASw-2613)
(NASA-CR-146397; SAI-1-120-194-T3) Avail: NTIS HC $4.50 CSCL 03B

Penetrators are missile shaped objects designed to implant electronic instrumentation in various of surface materials with a nominal impact speed around 150 m/sec. An interest in the application of this concept to in situ subsurface studies of extra terrestrial bodies and planetary satellites exists. Since many of these objects do not have atmospheres, the feasibility of successfully guiding penetrators to the required near-zero angle-of-attack impact conditions in the absence of an atmosphere was analyzed. Two potential targets were included, i.e., the moon and Mercury and several different penetrator deployment modes were involved. Impact errors arising from open-loop and closed-loop deployment control systems were given particular attention. Successful penetrator implacement requires: (1) that the impact speed be controlled, nominally to 150 m/sec, (2) that the angle of attack be in range 0 deg - 11 deg at impact, and (3) that the impact flight path angle be with 15 deg of vertical. Author

N76-18024*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STATUS OF AVAILABILITY OF LUNAR ORBITER TV PICTURE DATA Data Announcement Bulletin
Feb. 1976 6 p
(NASA-TM-X-72592; NSSDC/WDC-A-R/S-76-02-Suppl-1; NSSDC-69-05-Suppl-1) Avail: NTIS HC $3.50 CSCL 03B

The changes in availability of Lunar orbiter picture data since the issuance of 'Lunar Orbiter Photographic Data' are described along with the procedures for ordering these data. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N76-18025*# Scientific Translation Service, Santa Barbara, Calif.
PHYSICAL CHARACTERISTICS OF THE SOLAR WIND FROM DATA OF COMET OBSERVATIONS
V. P. Tarashchuk Washington NASA Feb. 1976 18 p refs Transl. into ENGLISH from Astrometriya i Astrofiz. (USSR), no. 21, 1974 p 62-69
(Contract NASw-2483)
(NASA-TT-F-16711) Avail: NTIS HC $3.50 CSCL 03B

The velocity distribution of the solar wind during maximum and minimum solar activity is studied as a function of the heliographic latitude on the basis of the observed behavior of the angles of declination of cometary tail axes from the continued radius vector. The deviation of a tail axis from the radius vector is assumed to be caused by the plasma flow propagating radially from the sun. Regions of increased and decreased solar wind velocity during an 11-year cycle are identified. Author

N76-18026*# Scientific Translation Service, Santa Barbara, Calif.
VELOCITY OF THE SOLAR WIND AT LOW HELIOGRAPHIC LATITUDES
V. P. Tarashchuk Washington NASA Feb. 1976 10 p refs Transl. into ENGLISH from Astrometriya i Astrofizika (USSR), no. 22, 1974 p 57-61
(Contract NASw-2483)
(NASA-TT-F-16710) Avail: NTIS HC $3.50 CSCL 03B

Data from comet tail deflection observations were used to analyze the relationship between the solar-wind aberrational velocity and the heliographic latitude in the near-equatorial region. The aberrational velocities are found to vary with heliographic latitude, decreasing near the equator and increasing over active solar regions. Active solar-wind zones are found to shift in the course of the 11-year solar-activity cycle. The mean solar-wind aberrations velocity is greater near the solar-activity mimimum than near the maximum. The aberrational velocity at 0.5-2.5 AU is independent of heliocentric distance. Author

N76-18027*# Stanford Univ., Calif. Inst. for Plasma Research.
THE RELATIVE ABUNDANCE OF NEON AND MAGNESIUM IN THE SOLAR CORONA
H. R. Rugge (Aerospace Corp., El Segundo, Calif.) and A. B. C. Walker, Jr. Jan. 1976 18 p refs
(Grants NsG-2049; NsG-7099)
(NASA-CR-146394; SU-IPR-650) Avail: NTIS HC $3.50 CSCL 03B

A technique is proposed for specifically determining the relative solar coronal abundance of neon and magnesium. The relative abundnance is calculated directly from the relative intensity of the resonance lines of Ne X (12.134A) and Mg XI (9.169A) without the need for the development of a detailed model of the thermal structure of the corona. Moderate resolution Bragg crystal spectrometer results from the OVI-10 satellite were used to determine a coronal neon to magnesium relative abundance of 1.47 + or - 0.38. The application of this technique to a recent higher resolution rocket observation gave an abundance ratio of approximately 0.93 + or - 0.15. Author

N76-18028*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORY OF TYPE 3b SOLAR RADIO BURSTS
Robert A. Smith and Jerome DelaNoee (Md. Univ., College Park) Oct. 1975 76 p refs Submitted for publication
(NASA-TM-X-71060; X-602-75-281) Avail: NTIS HC $5.00 CSCL 03B

During the initial space-time evolution of an electron beam injected into the corona, the strong beam-plasma interaction occurs at the head of the beam, leading to the amplification of a quasi-monochromatic large-amplitude plasma wave that stabilizes by trapping the beam particles. Oscillation of the trapped particles in the wave troughs amplifies sideband electrostatic waves. The sidebands and the main wave subsequently decay to observable transverse electromagnetic waves through the parametric decay instability. This process gives rise to the elementary striation bursts. Owing to velocity dispersion in the beam and the density gradient of the corona, the entire process may repeat at a finite number of discrete plasma levels, producing chains of elementary bursts. All the properties of the type IIIb bursts are accounted for in the context of the theory. Author

N76-18029*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FORMATION OF THE 0.511.-MeV LINE IN SOLAR FLARES
Carol Jo Crannell, Glenn Joyce, Reuven Ramaty, and Carl Werntz (Catholic Univ. of Am.) Jan. 1976 48 p refs Submitted for publication
(Grants NsG-5066; NSF ATM-72-01282)
(NASA-TM-X-71066; X-682-76-6) Avail: NTIS HC $4.00 CSCL 03B

The gamma-ray line produced at 0.51-MeV was studied and is shown to be the result of either of free annihilation of positrons

with electrons or of the decay of positronium by 2-photon emission. Positron annihilation from the bound state of positronium may also proceed by 3-photon emission, resulting in a continuum with energies up to 0.51-MeV. Accurate calculations of the rates of free annihilation and positronium formation in a solar-flare plasma are presented. Estimates of the positronium-formulation rates by charge exchange and the rates of dissociation and quenching are also considered. The temperature and density dependence of the ratio of 3-photon to 2-photon emission was obtained. It is shown that when the ratio of free electrons to neutral atoms in the plasma is approximately unity or greater, the Doppler width of the 0.51-MeV line is a function of the temperature of the annihilation region. For the small ion densities characteristics of the photosphere, the width is predominantly a function of the density. Author

N76-18030# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 372. PART 2: (COMPREHENSIVE REPORTS). DATA FOR FEBRUARY 1975 - JANUARY 1975 AND MISCELLANEA: EXPLANATION OF DATA REPORTS ISSUED NUMBER 366 (SUPPLEMENT) FEBRUARY 1975
Hope I. Leighton Aug. 1975 27 p
(COM-75-50193-372-2; SGD-372-Pt-2) Avail: NTIS; HC available from National Climatic Center, Attn: Publications. Federal Bldg., Asheville, N.C. 28891. Subscription $34.00/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.40/copy for either part; $1.30 for extra issue CSCL 03B

The February 1975 data includes sections on solar flares and solar radio waves. The January 1975 data includes sections on the Abbreviated Calendar Record and Regional Flare Index. Miscellaneous data includes sections on daily solar activity centers and geomagnetic indices. GRA

N76-18031# National Environmental Satellite Service, Washington, D.C.
OPERATIONAL PROCESSING OF SOLAR PROTON MONITOR DATA
Stanley R. Brown Sep. 1975 21 p refs Supersedes NOAA-TM-NESS-49 and COM-73-11647
(COM-75-11456/1; NOAA-TM-NESS-73; NOAA-73091908; NOAA-TM-NESS-49; COM-73-11647) Avail: NTIS HC $3.50 CSCL 03B

Operational processing of data obtained from the solar proton monitor sensor flown on environmental satellites of the new TIROS (television infrared observation satellite) series named ITOS (improved TIROS operational satellite) is described. Hardware systems aboard the ITOS are discussed and the software procedures relevant to the data recovery, recording, and transmission problems are described. Included are descriptions of tape formats, message formats, data location procedures, data frame contents, and a partial index of processed data available in archival form. GRA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N76-18032# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EXPERIMENTAL DETERMINATION OF ENERGY SPECTRUM OF ATMOSPHERIC GAMMA RAYS [DETERMINATION EXPERIMENTALE DU SPECTRE DES PHOTONS GAMMA DANS L'ATMOSPHERE A 12 GV DE COUPURE GEOMAGNETIQUE]
I. M. Martin, S. L. G. Dutra, R. A. R. Palmeira, G. Vedrenne, and F. Albernhe Jan. 1975 35 p refs In PORTUGUESE; ENGLISH summary
(INPE-588-RI/277) Avail: NTIS HC $4.00

The energy spectrum of atmospheric gamma rays from 0.9 to 18.0 MeV was measured as a function of altitude in a series of two balloon flights from Sao Jose dos Campos, Sao Paulo, Brasil (12 GV cut-off rigidity). The detector used was a 4' x 4' NaI(T1) crystal with a 1cm thick plastic scintillator anti-coincidence shield, connected to a 128 channel pulse height analyser. Above 20g/sqcm the energy spectrum could be fitted to a power law with exponent 1.0 + or - 0.1 independent of the altitude. From 20 to 760g/sqcm the spectrum was found to be somewhat steeper with the exponential index being 1.3 + or - 0.1. At 3.5g/sqcm the gamma ray flux was 0.30 photons/sqcm -s at 1 MeV. These measurements will be discussed and compared with calculated results. Author

N76-18033*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRONS IN A CLOSED GALAXY MODEL OF COSMIC RAYS
R. Ramaty and N. J. Westergaard (Danish Space Res. Inst.) Jan. 1976 35 p refs Submitted for publication
(NASA-TM-X-71052; X-660-76-19) Avail: NTIS HC $4.00 CSCL 03B

The consistency of positrons and electrons was studied using a propagation model in which the cosmic rays are stopped by nuclear collisions or energy losses before they can escape from the galaxy (the closed-galaxy model). The fact that no inconsistency was found between the predictions and the data implies that the protons which produce the positrons by nuclear reactions could have their origin in a large number of distant sources, as opposed to the heavier nuclei which in this model come from a more limited set of sources. The closed-galaxy model predicts steep electron and positron spectra at high energies. None of these are inconsistent with present measurements; but future measurements of the spectrum of high-energy positrons could provide a definite test for the model. The closed-galaxy model also predicts that the interstellar electron intensity below a few GeV is larger than that implied by other models. The consequence of this result is that electron bremsstrahlung is responsible for about 50% of the galactic gamma-ray emission at photon energies greater than 100 MeV. Author

N76-18034# Lockheed Missiles and Space Co., Palo Alto, Calif.
HIGH-LATITUDE IONOSPHERIC INHOMOGENEITIES FROM MEASUREMENTS ON THE KOSMOS-348
N. V. Dzhordzhio [1975] 7 p refs Transl. into ENGLISH from Geomagn. i Aeron. (USSR), v. 15, no. 5, 1975 p 825-831
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Measurements of ionospheric ion concentration and electron flux, obtained by Cosmos 348, are discussed. The relationship between intense intrusions of soft electrons and the origination of ionospheric inhomogeneities is considered. D.M.L.

N76-18035# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON EMISSION INTENSITIES OF OI 6300 A, OI 5577 A AND NI 5200 A FROM DATA OF ION COMPOSITION MEASUREMENTS IN THE NIGHT F2 REGION OF THE IONOSPHERE
M. N. Vlasov and Iu. A. Romanovskii [1975] 6 p refs Transl. into ENGLISH from Geomagn. i Aeron. (USSR), v. 15, no. 5, 1975 p 861-866
Avail: NTIS HC $3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Measurements of ion composition obtained by the mass spectrometer on the Cosmos 274 satellite were used to compute the emission intensities of OI 6300 A, OI 5577 A and NI 5200 A in the night F2 region. It was shown that the phenomenon of predawn magnification of the red emission of atomic oxygen can be due to a change in ion composition of the ionosphere in the predawn hours. Author

N76-18036# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 372. PART 1: (PROMPT REPORTS). DATA FOR JULY 1975 - JUNE 1975: EXPLANATION OF DATA REPORTS ISSUED AS NUMBER 366 (SUPPLEMENT) FEBRUARY 1975

Hope I. Leighton Aug. 1975 114 p
(COM-75-50193-372-1; SGD-372-Pt-1;
NOAA-75090806-Pt-1) Avail: NTIS; HC available from National Climatic Center, Attn: Publications, Federal Bldg., Asheville, N.C. 28801. Subscription $34.00/year includes Part 1 (Prompt Reports) and Part 2 (Comprehensive Reports); $18.00/year for either part. Annual supplement containing explanation is included. $1.40/copy for either part; $1.30 for extra issue CSCL 03B

The July 1975 Data includes sections on alert period, daily solar indices, solar flares, solar radio waves, solar wind measurements, spacecraft observations, solar X-ray radiation, and inferred IP magnetic field polarities. The June 1975 Data includes sections on daily solar activity centers, sudden ionospheric disturbances, solar radio waves, cosmic waves, geomagnetic indices, and radio propagation indices. GRA

99 GENERAL

N76-18037# Advisory Group for Aerospace Research and Development, Paris (France).

AGARD BULLETIN; MEETINGS, PUBLICATIONS, AND MEMBERSHIP

Jan. 1976 73 p refs
(AGARD-Bull-76-1) Avail: NTIS HC $4.50

Information on the following was presented: (1) all AGARD meetings planned for 1976, including dates, locations, and brief descriptions of their themes, (2) list of all AGARD publications released in 1975, together with their abstracts, (3) AGARD membership lists as of 1 January 1976. Author

N76-18038# Advisory Group for Aerospace Research and Development, Paris (France).

AGARD BULLETIN. TECHNICAL PROGRAM 1976

Jun. 1975 36 p refs
(AD-A010370; AGARD-Bull-75-2) Avail: NTIS HC $4.00 CSCL 05/2

A chronological listing of meetings scheduled for 1976 is presented. Detailed descriptions of AGARD programs and publications are included; these include panels on aerospace medicine, avionics, electromagnetic wave propagation, flight mechanics, fluid dynamics, guidance and control, propulsion and energetics, structures and materials, and technical information. M.J.S.

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